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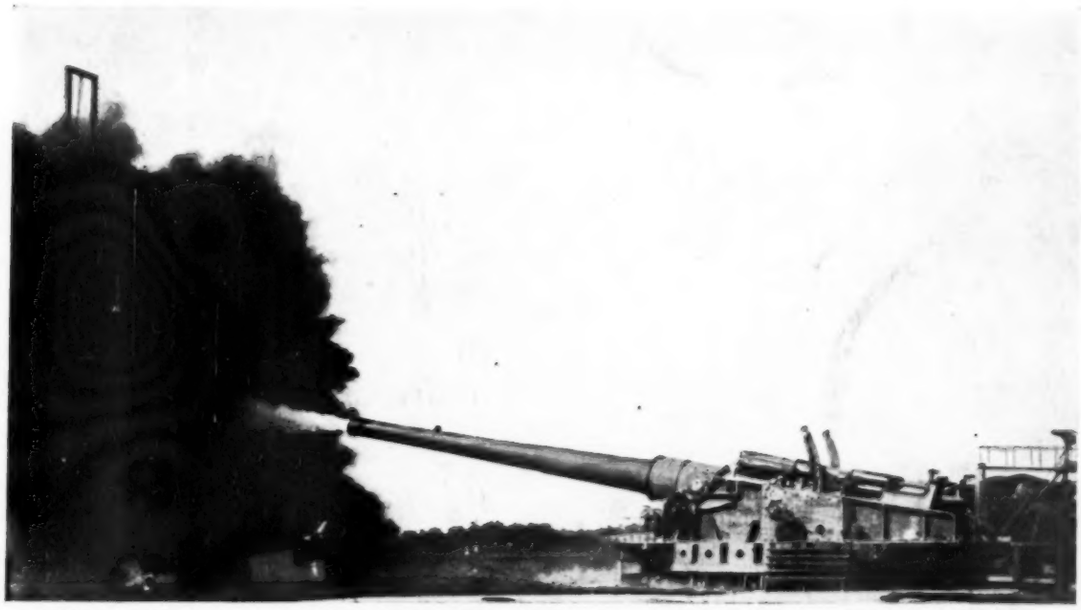

Firing the Nation's Largest Gun at the Eighth Annual Meeting of the Army Ordnance Association, Aberdeen Proving Ground, Md., October 8, 1926.

MANUFACTURE OF ORDNANCE IN VIRGINIA DURING THE AMERICAN REVOLUTION
Kathleen Bruce, Ph.D.

ORDNANCE BUDGET AND FISCAL SYSTEM
Maj. C. T. Harris, Jr., Ord. Dept., U. S. A.

COMMERCIAL HIGH EXPLOSIVES
Arthur LaMotte

PROJECTILES—SELFROTATING AND SELFPROPELLING
Maj. C. H. Goddard, Ord. Res., U. S. A.

INSTRUMENTS FOR MAKING BALLISTIC DETERMINATIONS
Maj. Arthur W. Ford, Ord. Dept., U. S. A.

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THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

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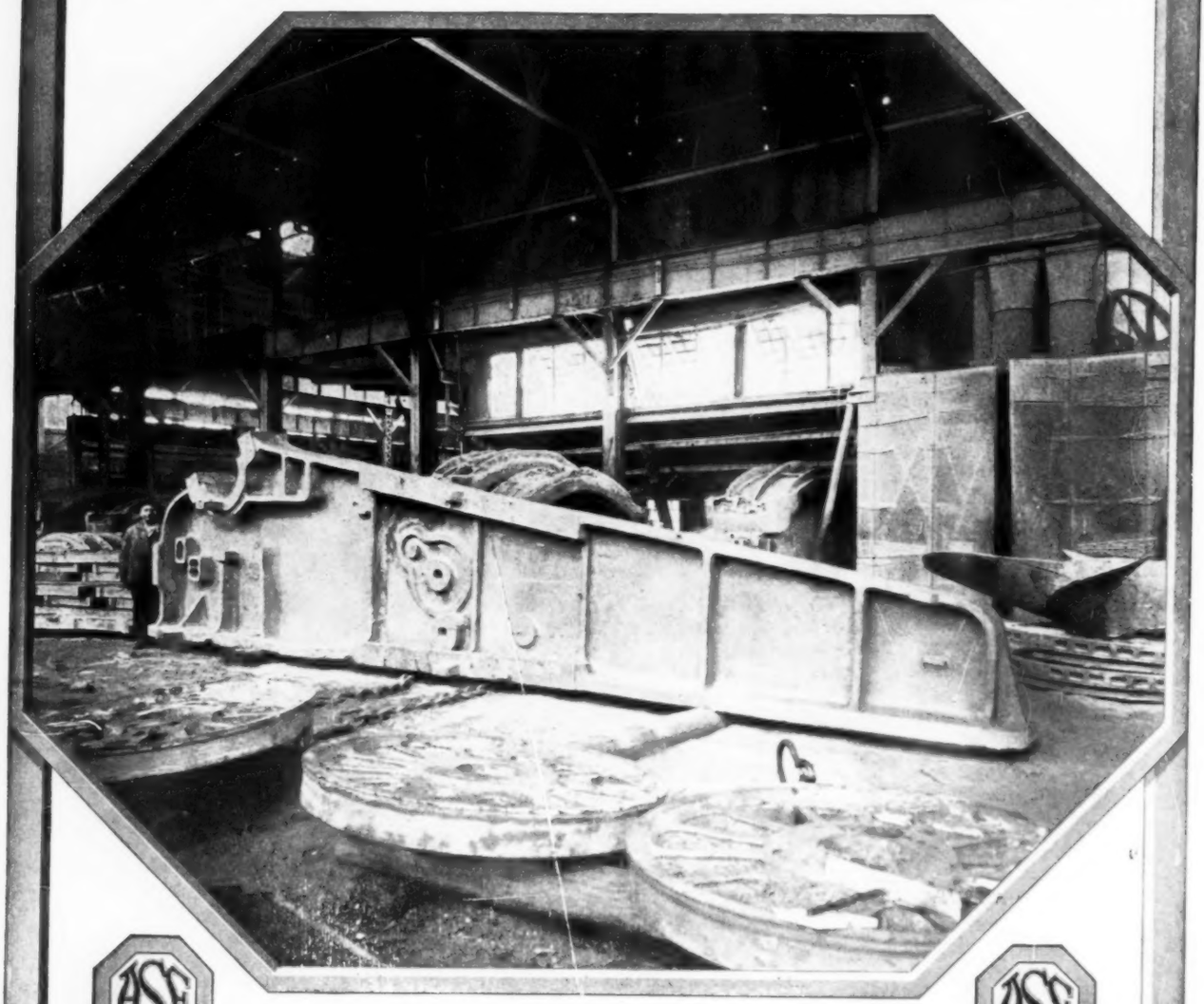

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ARMY AND NAVY REQUIREMENTS

NEW YORK CHICAGO ST. LOUIS

ARMY ORDNANCE

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION
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Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

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¶ The time has passed when military preparedness can be considered merely a question of trained manpower. The development of the methods of modern warfare must be supplemented with a knowledge of the methods of production of modern implements of war. Experience has shown that men can be mobilized and reasonably trained in from three to six months if the necessary ordnance is available. Industry today requires for mobilization and mass production of war material a period of from nine to eighteen months. The mobilization of the munitions industries is the ordnance problem.

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¶ But, a man, even a man of military training—well fed, well housed, well clothed, well paid—is not a soldier until he receives the tools of his trade. ORDNANCE.

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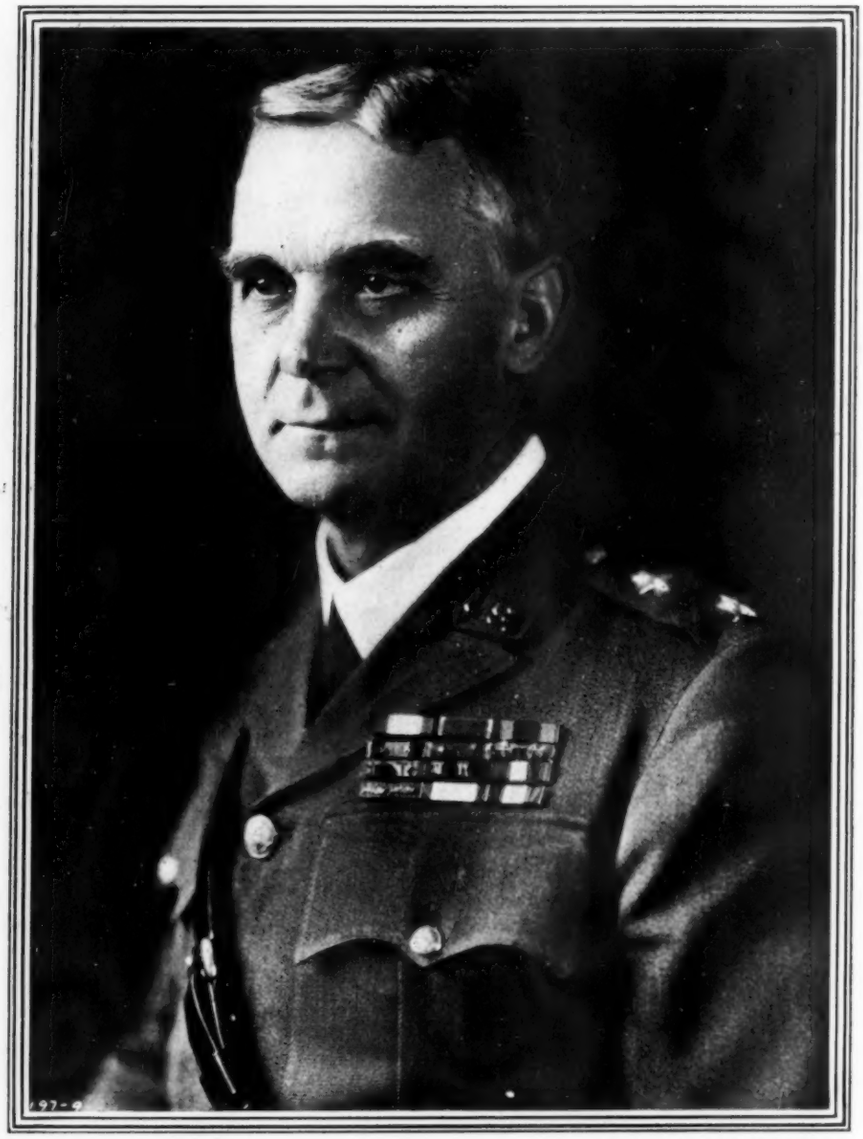


Underwood and Underwood

Maj. Gen. Charles P. Summerall,

Recently Appointed Chief of Staff, U. S. A.

Ordnance Budget and Fiscal System

Part I.

Maj. C. T. Harris, Jr., Ord. Dept. U. S. A.

IN discussing the subject of the Ordnance Budget and Fiscal System I shall treat it under three general categories: 1. Estimates, or the activities necessary to present to the Congress, through the established channels, the needs of the Ordnance Department for funds. 2. Appropriations, including a discussion as to what the various appropriation items are, what activities can be financed by them, the length of time funds are available for use, miscellaneous moneys received from sources other than direct appropriations, and similar questions. 3. The spending and accounting for the funds made available by the Congress.

I. ESTIMATES

In discussing estimates, again I would like to treat three phases of this subject. In this case, however, the division of phases is one of time: 1. The estimates of the pre-war Ordnance; 2. The estimates of the post-war Ordnance up to the passage of the Budget and Accounting Act; and 3. The estimates of the Ordnance Department since the passage of the Budget and Accounting Act.

In points of time the periods which I will discuss are roughly the fiscal years 1912 to 1916, 1919 to 1922 and 1922 to date.

Estimates of Pre-War Period

The Ordnance Department, before the war, received its funds from Congress upon the recommendation of numerous Committees. The funds for Ordnance Service, small arms, automatic rifles, small arms ammunition, and cleaning materials came in the Army Appropriation Bill. The funds for field artillery and seacoast artillery, including ammunition, came from the Fortifications Bill. Funds for the repairs of the various Ordnance facilities, for the items Testing Machines and Rock Island Bridge came in the Sundry Civil Bill, while the office force here in Washington was provided for in the Legislative, Executive and Judicial Bill. In each case the defense of the estimates was before the respective Committess which handled these appropriation bills. Presenting the estimates, therefore, even when they reached the Congress, was rather a disjointed performance with lapses of time between psesentation to Committees. Some Committeess seemed to be more liberal than others. The whole story was not told to any one Committee.

In those days there were no Directors of the Bureau of the Budget, no War Department Budget Officers, no Legislative Councils of the General Staff, no Chiefs of Finance, no Budget Advisory Committees in the War Department. There were, of course, certain governing plans of the War Department which were communicated to the Chief of Ordnance, but in general the Ordnance Department surveyed its needs, prepared its own estimates which, without very much analysis and usually with very little change, were grouped together in the War Department with the estimates of other Bureaus and sent to the Treasury Department. The Treasury Department simply grouped the estimates together, putting them in proper sequence and transmitted them to the Congress. The various Committees in Congress handling the particular subjects received the estimates in nearly all cases exactly as they were submitted by the Chief of Ordnance. When the Com-

Harris and Ewing

Maj. C. T. Harris, Jr., Ord. Dept., U. S. A.

mittees in Congress were ready to consider the Ordnance Department needs, the Chief of Ordnance, and such assistants as he desired to have, went up to the Committee rooms, and, in the hearings, were usually the only War Department officials present.

I am mentioning these things in detail more for the purpose of contrasting them with present conditions than for any other purpose.

Having stated that the estimates went to Congress without being analyzed in detail by anybody outside the Ordnance Department and perhaps implying by that that the system was not good, which I must state is my opinion, I will *now* say that the estimates were very well prepared indeed and most excellently presented to the Committees in Congress. It is surprising how the Ordnance Department under General Crozier was able to get from Congress almost everything they asked for in a day when the asking was very cheap. In the pre-war years the amounts estimated for and the amounts appropriated were as follows:

Fiscal Year.	*Estimated.*	*Appropriated.*
1912	$ 9,601,530	$ 8,896,305
1913	13,480,595	8,027,363
1914	11,295,297	9,821,141
1915	17,556,339	12,356,432
1916	13,767,689	13,567,110

The large differences in 1913 and 1915 represent unsuccessful attempts on the part of the Chief of Ordnance to convince Congress of the necessity of speeding up the preparedness measures which were moving along rather slowly. It would certainly have been money well spent if the Congress had listened to General Crozier at that time. These extra $10,000,000 might have resulted in our using our own artillery in the war and saved much confusion and many months in time.

In the pre-war years, as I stated before, there was no Chief of Finance, the Ordnance Department did its own disbursing and did its own accounting, and did both well. A very careful check was made on all money affairs and it is interesting to note that of all the funds available to the Ordnance Department from all appropriations it turned back into the Treasury only the small amounts set forth below:

1912	$13,400.19
1913	7,353.21
1914	6,226.79
1915	3,782.59
1916	34,407.01

In passing to the post-war period, I will pause just long enough to mention as a matter of interest that there was appropriated for the Ordnance Department's use in the world war $8,000,000,000 of actual cash and that an additional $8,000,000,000 in contract authorizations was provided. The Ordnance Department disbursed in the United States, in Europe and in the settlement of claims $4,445,504,854. There was appropriated for the use of the Ordnance Department during approximately the last year of the war about 1,000 times as much as is now appropriated for one year's operation of the Ordnance Department.

Estimates of Post-War Period, Including Fiscal Year 1922

In passing to the subject of estimates in the post-war period, bear in mind that the conditions as to the Committees in Congress, the absence of Budget Officers and other coordinating agencies connected with estimate work still existed. The Chief of Finance was created in the National Defense Act, approved June 4, 1920, but he had no influence at this time on the estimates. Having just passed through the greatest war in history, the wide horizon of vision, the big ideas, and the familiarity with big figures still existed, although the Armistice had been signed. Congress, too, still was in rather a beneficent mood, although I recall at that time we considered them to be quite hard-boiled. To illustrate these points, I might state that for the fiscal year 1920, the estimates for which were presented to the Congress just prior to the Armistice, the Ordnance Department asked to have appropriated a total of $836,000,000. Congress appropriated $19,500,000, and for the fiscal year 1921, the estimates for which were prepared and presented a year after the Armistice, the Ordnance Department asked for $108,000,000 and received $22,750,000. In the fiscal year 1922, still a year later, the Ordnance Department asked for $47,250,000 and received $13,500,000. Here ended the post-war period up to the operation of the Budget and Accounting Act.

Now, even though the Congress only appropriated a really small fraction of what the Ordnance Department asked, there were returned unused to the surplus fund of the Treasury, of the amounts actually appropriated, the following sums:

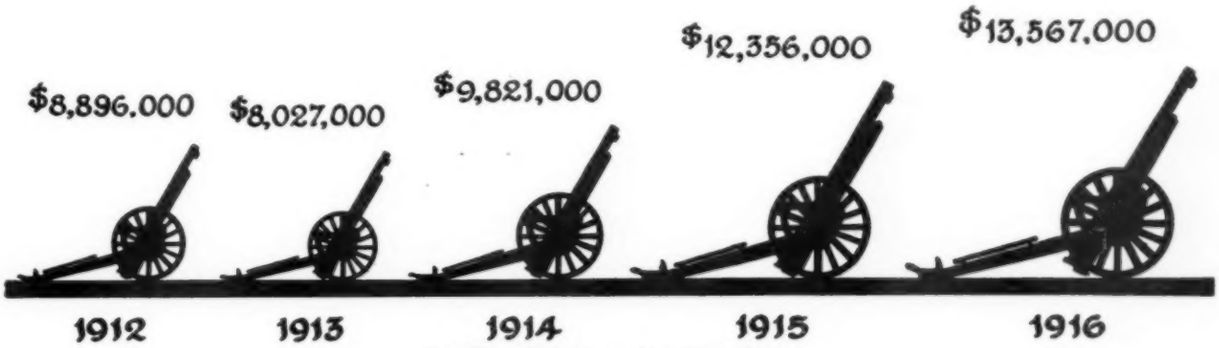
Fiscal Year.	*Amount Returned to the Treasury.*
1920	$1,646,000
1921	1,015,000
1922	1,777,000

I mention the above not in criticism but to show to what extent the big ideas we brought over from the war still existed and to show that the accounting systems had not yet gotten back to a basis that could insure to the Ordnance Department the use of the funds they actually had available to them.

This second phase of estimates, that is from the end of the war to the passage of the Budget and Accounting Act, is entirely familiar to me as I was at that time on duty in the Ordnance Office and had certain responsibilities connected with estimates, both in their preparation and in their presentation to the Congress. People were trying the hardest they knew how, to do what was right, they were using the data available to them. For example, the figures showed a large shortage of seacoast armor piercing projectiles below the amounts officially stated by the War Department to be required, and naturally the Ordnance Office had only the alternative of asking Congress for these projectiles, although the amount of money involved in this particular item was $32,000,000; $32,000,000 did not frighten anybody at that time. We were still too close to the time we were spending billions.

In presenting these estimates to the Congress we still had the numerous Committees to talk to and, due to the fact that the Chief of Ordnance had so many responsibilities in demobilizing, closing out contracts, settling war claims, putting material left over from the war in proper storage, disposing of surplus property, preparing plans for peace-time operations, etc., it was not possible for him to give the necessary time to go personally, as he now does, to explain to the Committees of Congress the needs of the

Ordnance Department. The system was therefore adopted of having the officers in charge of the various Divisions which were asking for funds explain their own needs. These officers had prepared their estimates and made earnest endeavor to acquaint the Committees of Congress with the problems involved, but there were probably, altogether, a dozen officers of the Ordnance Department appearing before Congressional Committees. Some were quite self-possessed and made excellent presentations. Others with just as much data available to them were self-conscious, embarrassed, and in some cases made a poor presentation. At best, under this system, there was great lack of uniformity in presenting the estimates. Here again there is no desire on my part to criticise anybody. I was one of those officers and I am sure my arguments in support of $32,000,000 for armor piercing projectiles were not convincing—at least Congress did not appropriate the money.



Pre-War Ordnance Appropriations

Estimate Work Since the Passage of the Budget and Accounting Act

From a budget standpoint the date of June 10, 1921, marks the beginning of a new epoch, for on that date was approved by the President an Act of Congress to provide a centralized budget control and an independent audit of Government accounts—in other words, a national budget system and a national accounting system. Two very important Government officials were created in this Act, the Director of the Bureau of the Budget—(the first being General Dawes, and his successor, the present incumbent, General Lord)—and the Comptroller General of the United States, an official who holds office for fifteen years, is independent of executive control and not eligible for reappointment. The present incumbent is Mr. McCarl.

We will now discuss the Budget System.

Under the Budget and Accounting Act the President of the United States looms large in the picture as the directing and controlling head of the Government. He now emphasizes his leadership from a money standpoint, in that he transmits each year to the Congress the budget that he desires them to provide funds for, and nothing that is not included in his budget can be asked of Congress. This is not an empty phrase, as all Departments can testify. The President, through the Director of the Bureau of the Budget, decides what constitutes the budget and this limits everybody in requests for money.

The Budget and Accounting Act created the Director of the Bureau of the Budget in the following Section:

"207. There is hereby created in the Treasury Department as Bureau to be known as the Bureau of the Budget. There shall be in the Bureau a Director and an Assistant Director, who shall be appointed by the President and receive salaries of $10,000 and $7,500 a year, respectively. The Assistant Director shall perform such duties as the Director may designate, and during the absence or incapacity of the Director or during a vacancy in the office of Director he shall act as Director. The Bureau, under such rules and regulations as the President may prescribe, shall prepare for him the Budget, the Alternative Budget, and any supplemental or deficiency estimates, and to this end shall have authority to assemble, correlate, revise, reduce, or increase the estimates of the several departments or establishments."

The next step in the budget chain, as far as concerns us, is the provision for a War Department Budget Officer. The provision for this officer and his duties are set forth as follows:

"Sec. 214 (a) The head of each Department and establishment shall designate an official thereof as budget officer therefor, who, in each year under his direction and on or before a date fixed by him, shall prepare the departmental estimates.

"(b) Such Budget officer shall also prepare, under the direction of the head of the department or establishment, such supplemental and deficiency estimates as may be required for its work."

The Secretary of War has this responsibility:

"Sec. 215. The head of each department and establishment shall revise the departmental estimates and submit them to the Bureau on or before September 15th of each year. In case of his failure so to do, the President shall cause to be prepared such estimates and data as are necessary to enable him to include in the Budget estimates and statements in respect to the work of such department or establishment."

General Lord was the first War Department Budget Officer. When he was appointed Director of the Bureau of the Budget he was succeeded as War Department Budget Officer by General Kenzie B. Walker.

Following the Budget chain still further, there was appointed in the Ordnance Department a Fiscal Officer for the Ordnance Department. The present Fiscal Officer for the Ordnance Department is the Chief of Ordnance himself. It is my privilege and pleasure to be his assistant.

Now let me go back for a moment and mention that the National Defense Act, approved June 4, 1920, made provision for the appointment of the Assistant Secretary of War and set forth certain duties which he should assume, the most important one of which was to insure the neces-

sary plans and arrangements that industrial mobilization in time of war would be successfully achieved. The Office of the Assistant Secretary of War has from year to year gained a truer appreciation of its responsibilities and duties, and a keener realization of the relation of budget affairs to the successful performance of these duties. As a consequence, the Assistant Secretary of War and his office realize that to better do their work they must have an intimate connection with and a helping and guiding hand in all budget matters. The necessity of the Assistant Secretary of War participating in budget affairs has caused considerable study of the whole subject and as a result the following budgetary procedure was adopted by the War Department in October, 1925. This document sets forth the method of preparing the War Department budget each year, the method of presenting this budget to the Congress, and the method of apportioning funds to the proper bureaus when appropriated.

War Departmemnt Budgetary Procedure

"War Department,
"Washington, October 29, 1925.

"ORDERS.

"The following is prescribed as the War Department budgetary procedure:

"1. Channels of Communication.

"a. The office of the budget officer is the channel of communication with the Bureau of the Budget and is the office of record of all Budget correspondence and other Budget records. All estimates, requests for apportionments, and other Budget matters, from whatever source, will be sent directly to that office. Original papers, bearing the signature of the Secretary of War, or of an officer or an official hereafter authorized to approve financial papers in his name, including apportionments or modification of apportionments, will be returned to the Budget officer, and those affecting apportionments furnished by him to the Chief of Finance for the latter's files.

"b. The channel of communications in fiscal affairs requiring the action of the Secretary of War will be as follows:

"(1) Those pertaining to civil works, not included in the duties of the Assistant Secretary of War as assigned by the Secretary of War, will be submitted direct to the Secretary of War.

"(2) Those pertaining to the duties of the Assistant Secretary of War, as prescribed by the National Defense Act, or as assigned by the Secretary of War, will be submitted through the Assistant Secretary of War.

"(3) Those pertaining to the duties of the General Staff, as prescribed by the National Defense Act, will be submitted through the Chief of Staff.

"(4) Those pertaining to both Nos. 2 and 3 will be submitted through the authority primarily concerned whose duty it will be to obtain the concurrence or action of the other before submission of the subject to the Secretary of War.

"2. War Department Program.

"The Secretary of War in war council will issue annually a general directive governing the preparation of the War Department program covering both civil and military affairs for the next fiscal year. In conformity with this general directive the plans and policies governing the preparation of estimates for funds for military purposes and priorities pertaining thereto will be prepared by the Chief of Staff; those relating to the duties of the Assistant Secretary of War will be prepared by him, and the figures relating to matters handled direct by the Secretary of War will be compiled for him by the Budget Officer. Based upon this information, the Secretary of War in war council will draw up the War Department program which will be used by the Budget Officer as the basis of his call on the estimating agencies of the War Department for estimates.

"3. Estimates.

"The Budget Officer is responsible for the preparation of the War Department estimates in conformity with the War Department program. He will transmit to the estimating agencies such information and instructions as are necessary to insure the fulfilment of his responsibility. In the preparation of the annual estimate for items not handled directly by the Secretary of War, and for such other estimates as may appear desirable, the Budget Officer will utilize the assistance of a Budget Advisory Committee composed of representatives of the Assistant Secretary of War, of the Chief of Staff, and of the Budget Officer. The composition of this committee will be decided annually by the Secretary of War. The Budget Officer will transmit his original report on the consideration of the estimates, together with a report from the Budget advisory committee, to the Secretary of War; copies will be forwarded at the same time to the Assistant Secretary of War and the Chief of Staff. The Assistant Secretary of War and the Chief of Staff will have these reports studied by their respective subordinate agencies and will present their recommendations thereon to the Secretary of War in war council. For the consideration of the general directive, the program, and the estimates, the Secretary of War will normally utlize the war council, the Budget Officer being present to furnish such explanations and information as may be required. Revisions of the estimates will follow the same general procedure outlined above. After approval by the Secretary of War the estimates will be transmitted by the Budget Officer to the Director of the Bureau of the Budget.

"4. Hearings.

"The Budget Officer will utilize the Budget Advisory Committee to hold preliminary hearings and to assist the estimating agencies in preparing their evidence to present to the Bureau of the Budget and to the committees of Congress. The Budget Officer will be the contact representative of the War Department and responsible for the presentation of estimates at hearings before the Bureau of the Budget and of the committees of Congress. He will arrange for the attendance of witnesses and for the furnishing of information.

"5. Apportionments.

"The Budget Officer will prepare the original apportionments for the War Department appropriations and will submit them to the Secretary of War through the regular channel of communications prescribed in 1 b. Withdrawals from the general reserve or reapportionments will follow the same channel.

"6. Advisory Duties of the Budget Officer.

"The Budget Officer is charged with the responsibility of keeping the War Department informed on Budget matters and will use the channel of communications prescribed in 1 b in transmitting reports or recommendations on Bud-

Important Steps in the Procurement of Ordnance Funds

1. GENERAL STAFF AND OFFICE OF ASSISTANT SECRETARY OF WAR CONSIDER PROJECTS FOR COMING YEAR.

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2. BUDGET PLAN PREPARED BY WAR COUNCIL AND APPROVED BY SECRETARY OF WAR.

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3. ORDNANCE DEPARTMENT FISCAL OFFICE RECEIVES BUDGET PLAN AND DIRECTS VARIOUS ORDNANCE SERVICES TO SUBMIT ESTIMATES THEREUNDER.

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4. ORDNANCE DEPARTMENT FISCAL OFFICE PREPARES PRELIMINARY ESTIMATES.

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5. WAR DEPARTMENT BUDGET OFFICER AND BUDGET ADVISORY COMMITTEE ANALYZE PRELIMINARY ORDNANCE ESTIMATES TO CONFORM WITH WAR DEPARTMENT BUDGET PLAN.

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6. SECRETARY OF WAR DETERMINES WAR DEPARTMENT BUDGET.

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7. CHIEF OF ORDNANCE REVISES PRELIMINARY BUDGET TO CONFORM WITH WAR DEPARTMENT BUDGET AND PREPARES ORDNANCE PROGRAM FOR INCORPORATION IN WAR DEPARTMENT BUDGET.

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8. WAR DEPARTMENT BUDGET IS SUBMITTED TO DIRECTOR, BUREAU OF THE BUDGET.

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9. DIRECTOR, BUREAU OF THE BUDGET HOLDS HEARINGS ON ORDNANCE ESTIMATES WHICH ARE DEFENDED BY THE CHIEF OF ORDNANCE IN PERSON.

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10. DIRECTOR, BUREAU OF THE BUDGET, SUBMITS BUDGET TO THE PRESIDENT.

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11. THE PRESIDENT TRANSMITS BUDGET TO CONGRESS.

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12. HOUSE APPROPRIATIONS COMMITTEE HOLDS FORMAL HEARINGS ON WAR DEPARTMENT BUDGET; THE CHIEF OF ORDNANCE, IN PERSON, PRESENTS THE ORDNANCE ESTIMATES.

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13. HOUSE APPROVES OR REVISES THE BUDGET AND TRANSMITS IT TO THE SENATE.

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14. SENATE APPROPRIATIONS COMMITTEE HOLDS FORMAL HEARINGS ON HOUSE BILL; THE CHIEF OF ORDNANCE, IN PERSON, PRESENTS ORDNANCE ESTIMATES.

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15. THE BUDGET IS AGREED UPON BY THE CONGRESS, ENACTED INTO LAW AND SIGNED BY THE PRESIDENT.

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16. SECRETARY OF WAR APPORTIONS TO THE ORDNANCE DEPARTMENT ITS FUNDS UNDER THE BUDGET AS APPROVED BY CONGRESS.

get matters. He is authorized to secure direct from all War Department agencies by authority of the Secretary of War such information as he may deem necessary in the accomplishment of his duties.

"7. Proposed or Pending Legislation.

"Proposed or pending legislation which affects the fiscal matters of the War Department will be referred to the Budget Officer for his comment before being submitted to the Secretary of War for final action.

"8. Conflicting Orders Repealed.

"All orders or instructions in conflict with the foregoing are hereby rescinded. Dwight F. Davis,
Secretary of War."

In order to make the budget system operate consistently and logically Congress found it necessary to do a little internal rearranging and consequently in 1921:

"The two Houses of Congress reorganized so that the estimates of the various Departments could be coordinated and consideration be given to the whole in its relation to the Government's income. The House created the present large Appropriation Committee, of which Mr. Madden is the present Chairman, and to this powerful committee goes the entire Government's budget when it is received from the President. This Committee is divided into the necessary sub-committees that hold hearings and make recommendations to the whole Committee as to the appropriations which they think should be made.

"The sub-committee which handles the War Department estimate has a Chairman, Mr. Anthony. The recommendations of all the sub-committees are submitted to the whole Committee and carefully reviewed so as to have them properly coordinated and have the total within the Government's income." (General Walker's Lecture to the War College, December 11, 1925).

Having set forth the various agencies in the budget chain, I will now endeavor to describe one estimate cycle:

Along in January of any year (say 1926), the War Department officials begin consideration of the budget for the fiscal year two years later (fiscal year 1928). At that time the estimates for the fiscal year one year later (1927) have usually been presented to the Committees of Congress and it is generally known approximately what the War Department will get, although the appropriations have not usually been made. Along about this time the War Department General Staff and the office of the Assistant Secretary of War begin to consider what projects shall be included. Many studies are made and we are informally consulted by both agencies. From these studies, the War Council draws up its Budget plan which, when approved by the Secretary of War, forms the basis upon which the Budget Officer for the War Department prepares his directive for the preparation of the estimates. The size of the army, the amount of war reserve ammunition turnover, the degree of training not only the Regular Army but all other elements of the United States Army, the amount of provision for target practice—all these things enter into the determination of the directive. Up to this year we have had no formal plan or directive. I am talking about the new Budgetary Procedure rather than what has happened in previous years. The Directive should be issued early in the spring and it will tell us enough about the plans to enable us to estimate for our part in this plan. As a matter of fact, in the Ordnance Department we must provide for many things not considered in the yearly War Department plan. Our work does not hinge upon any particular War Department plan, since we have our development work, our maintenance of stores, and other activities which do not depend in any degree upon the size of the army or the training plan of the army.

Whatever the directive we receive, whether formal or informal, full or incomplete, the fiscal office of the Ordnance Department calls upon the various services in the Ordnance Office to present by a certain date their requirements for the fiscal year in question. When each Chief of a Division receives this call he analyzes his needs, he considers the things he has been told to provide for, and submits his requirements under the various appropriation items using the project system.

I would like to discuss the project system in detail, but space will not permit.

When all the estimates are received in the fiscal office they are analyzed, discussed with the fiscal officer who, as stated above, is the Chief of Ordnance himself, and, as a result of his conclusions, a preliminary set of estimates is prepared and forwarded to the War Department Budget Officer. Many conferences are held in drawing up these estimates. The preliminary estimates go forward usually around June 1st, but as a matter of fact it is on the call of the Budget Officer and the date varies. I might state that the only absolutely fixed date in connection with budget affairs is that on September 15th of each year the War Department estimates for the following fiscal year go to the Director of the Bureau of the Budget.

The Budget Officer of the War Department in his analysis and study of the estimates is assisted by a very important Committee, the Budget Advisory Committee, at the present time headed by Lt. Col. G. P. Tyner, of the G-4 Section of the General Staff. This Committee is composed of field officers representing the Office of the Assistant Secretary of War, the various Divisions of the General Staff and the Budget Officer of the War Department. From June 1st to July 15th, and from August 15th to October 31st of any year, this Committee is in almost continuous session and they have to work extremely hard, because they do all the fitting, cutting and adjusting of figures necessary to make the War Department estimates come within the amount of funds the President is willing that the War Department shall have.

As the assistant to the Fiscal Officer of the Ordnance Department, a large part of my work has to do with estimate preparation and estimate presentation. Many times between June 1st and November 1st we appear before this Budget Advisory Council. In the beginning the hearings are more or less informal and we present in detail the Ordnance budget which has been approved by the Chief of Ordnance. This usually takes two or three days. Then from that day on until September 1st there is not a week that passes that I am not sent for to come down immediately to answer all sorts of questions. These questions are sometimes of small importance and sometimes of extreme importance, but the Budget Advisory Committee must have a definite answer or else they will answer the question themselves. I have endeavored in my dealings with them to know my subject, to know the wishes of the Chief of Ordnance, and then talk with full confidence. It

has worked pretty well. During this period from June 1st to September 1st the Ordnance figures have been squeezed, and new totals have been set up. We have sent these new figures down to the various services, and they have recast their figures accordingly. Each time all the Ordnance needs are considered and, if there is a cut, the attempt at least is made to make it equitably. There will probably not be unanimous agreement as to this, but at least the effort has been made.

In all reductions in the budget, except for such outstanding and important projects as, for example, the turnover of war reserves of ammunition, the Chief of Ordnance is usually allowed to adjust the reduction over the appropriation items as he thinks best.

Along in the latter part of August the Secretary of War, in consultation with the Chief of Staff on the one hand and the Assistant Secretary of War on the other, has crystallized about what the War Department program will be and what projects will be included in it.

At this time we are given a limiting figure which our estimates must not exceed. In some cases we are told what the limiting figure in each appropriation item will be. With this figure the Chief of Ordnance tells each of the services what their figures will be, and, working together in conference between the various offices and divisions and the fiscal office, the Ordnance program is drawn up, stating in detail the projects to be provided for, the amount of money to be asked for each, and the final defense is drawn. We then make up our preliminary book of estimates. It may be necessary to change this a little later on, but usually it stays about as it is. Early in September we are told definitely by the Budget Officer what the War Department will ask for and what we may ask for. The estimate book is finally changed, if necessary, and we furnish a number of copies of the estimate book for use of the War Department officials and the Director of the Bureau of the Budget.

On September 15th the War Department budget goes to the Director of the Bureau of the Budget. In his office there are several officials who are in contact with the various departments of the Government. Major Dasher, a Reserve Officer, is the liaison man with the War Department. During the next couple of months we hear echoes of the budget from visits of Major Dasher to ask questions about certain things, seeking detailed data as to the amount of stocks on hand, and other data. In some cases the representative of the Director of the Bureau of the Budget has actually visited Ordnance establishments. Last fall, for example, Major Dasher, with our full encouragement and by our agreement, visited the Aberdeen Proving Ground, the Raritan Arsenal and the Picatinny Arsenal. The physical impressions he got from those places are still so keen in his mind that he speaks of them almost every time we meet. He gave General Lord a very clear picture of conditions, as far as repair needs were concerned.

About the last of October or the first of November one of our major barriers in estimate work is approached. The Director of the Bureau of the Budget holds a formal hearing. The Chief of Ordnance personally presents the Ordnance Department's needs. He is accompanied usually by some officer who has been working on the subject and who is familiar with the details.

I will attempt to describe the last budget hearing as typical. The Director of the Budget in person held the hearing, sitting on one side of a double desk. The Chief of Ordnance sat directly across the desk from him, and I sat at the Chief of Ordnance's right hand, surrounded by voluminous data. Although our estimates were all in one book, we never know what question is going to be asked, and we try to take up all the data we can to answer these questions. At these hearings there was a representative of the General Staff sitting in the room; likewise a representative of the other Supply Departments and some of the Branches. The Director of the Bureau of the Budget picked up our own estimate book that we prepared, and announced that he had read it through the night before and his later questions showed that he had. This estimate book was nearly 100 pages long. I will not go into detail about the hearing, but you have got to know your lesson when you go before General Lord, because he is not afraid to study the lesson himself. General Lord made some very complimentary remarks about our Chief and the Ordnance Department, and I think we escaped unscathed. General Lord gave a very searching hearing into our needs, especially in the appropriations of general application, such as Ordnance Service, Repairs of Arsenals, Proving Grounds, Army, etc. He showed a surprising knowledge of our problems. The amount of study that must be required of a man in his position to exhibit the knowledge he did of Ordnance matters must be very taxing.

This hearing before General Lord usually occupies two full mornings, say five hours total.

At the opening of Congress, which convenes early in December of each year, the budget of the United States Government, including the budget of all the Departments, is transmitted by the President in bound form to the Congress. We now learn definitely what the figures are under our particular appropriation items. We then rearrange our budget book to agree with the figures which have been presented to the Congress, and prepare an abbreviated estimate book having usually one page only to an appropriation. It is not an easy matter to write on one page a convincing story for $1,000,000. I know because I have tried it.

At the pleasure of the War Department Sub-Committee of the House Appropriations Committee, of which Sub-Committee Mr. Dan. R. Anthony of Kansas is chairman, the Ordnance Department is called to explain to the Committee its estimates and the necessity for the various amounts required. At these hearings minutes are taken. This is the first time that verbatim notes have been taken in the estimate chain. The hearings are usually held in one of the Committee rooms in the Capitol Building, with the chairman of the Committee sitting on one side of a long table. The other members of the Sub-Committee are arranged on the right and left of the chairman. The witnesses are across the table. The reporters sit at the ends of the table. During the last hearings of the Ordnance Department there were present the Assistant Chief of Staff, G-4; the Chief of Coast Artillery, the Chief of Infantry, a representative of the Chief of Cavalry, an officer from the Field Artillery, the Budget Officer for the War Department, and representatives of several divisions of the General Staff. I might add that Mr. C. E. McRae was also present. Mr. McRae has been working on finances in the Ordnance Department for many years and at my sug-

gestion he this year for the first time heard the Ordnance estimates presented to the Congress. It is of interest that thirty years ago Mr. McRae's cousin, another Mr. McRae, a member of Congress from Arkansas, was a member of this same Appropriations Committee and used to ask very pertinent and searching questions about Ordnance appropriations.

General Williams presents the Ordnance estimates in person, again attended by some officer who has been working on the subject and presumably is familiar with all the details. The Chairman of the Committee and each member of the Committee have in front of them a large book on each sheet of which is written an appropriation title, the remainder of the sheet being left for their notes. We found, however, that each member of the Committee had one of our little abbreviated estimate books and it was very nice for us that they used this estimate book largely during the hearings. It was not only that the estimate book told the best story we knew how to tell, but at the same time we were on familiar ground. Our abbreviated estimate book was copied into the record. In the last few years the system of having this abbreviated estimate book prepared has grown up and if we have the ability to make it concise and tell a true story of our needs we have the best opportunity of putting in the record the most convincing plea we know how to make for funds.

The hearings before the War Department Sub-Committee of the House Appropriations Committee usually take the equivalent of one full day. Later at the pleasure of the War Department Sub-Committee of the Senate Appropriations Committee, of which Sub-Committee Senator Wadsworth is chairman, we again appear to explain the estimates. As a matter of fact, the Senate Committee seldom goes into detail except in those items which the House has not acted upon favorably. In other words, if we want more than the House has given us—if we desire something further, we must prove our case. If we are contented with what is in the bill there is very little discussion in the Senate Committee.

Here ends the estimate presentation and we await the action of Congress when the final bill is passed. Then we know definitely what we have for the fiscal year in question.

Many times have I heard the statement made that Congress is not sympathetic to the War Department needs. When the War Department bureaus do not get the amount of money they want, they are sometimes prone to criticise Congress. My own opinion is that Congress is very sympathetic and that within reason a good case will receive favorable consideration. Do not get the idea for a moment that the members of Congress on those committees do not know anything about the War Department. I venture the statement that Mr. Anthony, Chairman of the War Department Sub-Committee of the House Appropriations Committee, knows as much about all phases of the Army as any man in the Army. The same statement goes for Mr. Swager Shirley, of Kentucky, who was chairman of this Committee during the Democratic administration.

In the discussion of the various steps in estimate presentation I would like to call attention to the fact that, after each unit approves your estimate, from that time on it becomes a champion for your figures. Mr. Anthony, chairman of the Sub-Committee, on the floor of the House defends the figures he accepts and defends them very effectively. The members of the House Committee show quite a bit of interest in Ordnance matters. In fact, since the hearings Mr. Barbour of California, and Mr. Clague of Minnesota, accompanied by Colonel Tynor of the General Staff, visited the Proving Ground to see what was going on there. Both the above gentlemen are members of the War Department Sub-Committee of the House Appropriations Committee.

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National Association of Manufacturers Holds Industrial Preparedness Meeting

THE closing session of the annual convention of the National Association of Manufacturers, held in New York City, October 5, 6 and 7, 1926, was devoted to industrial preparedness. The meeting was held in the main banquet hall of the Waldorf-Astoria Hotel, October 7th, beginning with luncheon at 1 P. M. Mr. John E. Edgerton, President, National Association of Manufacturers, presided. There were about four hundred members of the Association in attendance.

Addresses emphasizing the importance of industrial preparedness and the need for cooperation by American industry were made by Hon. Elbert H. Gary, Chairman, U. S. Steel Corporation, who is also Chairman of the Advisory Board of the New York Ordnance District; Col. Hanford MacNider, Assistant Secretary of War; Hon. Benedict Crowell, President, Army Ordnance Association, and former Assistant Secretary of War and Director of Munitions during the World War; Maj. Gen. C. C. Williams, Chief of Ordnance; and Col. James L. Walsh, Chief, New York Ordnance District.

At the close of the convention many members of the National Association of Manufacturers went by special train to Aberdeen Proving Ground, Md., where that Association participated in the Eighth Annual Meeting of the Army Ordnance Association the following day.

The Manufacture of Ordnance in Virginia During the American Revolution

Part I.

Kathleen Bruce, Ph. D.*

IN those two heroic periods, the period of the war of the American Revolution and the period between April 1861 and April 1865, the planting ideal dominated Virginia. But in 1861 the iron industry pursued in the Commonwealth, which caused the Confederate leaders, as I have tried to show in a previous paper published in ARMY ORDNANCE (Vol. VI, No. 33, pp. 166-173 and Vol. VI, No. 34, pp. 259-264), to remove their seat of government from the lower border to the northern frontier of the Confederacy, was the dramatic climax in the history of an industry which bold Englishmen introduced into the colony. By 1775 the business of iron-making was rooted in Virginia, but it had not yet captured the imaginations and the energies of even a strong minority of Virginians. With one or two exceptions it was still in the hands of aggressive immigrants. It is, therefore, not strange that the expansion which the industry enjoyed from 1775 to 1782 was due to the influence of war and did not last. Like the scullion in the fairy tale who goes to the ball garbed as a princess only to have her magic robes at a fateful hour give place to her kitchen frock, the Virginian industry, responding to the needs and the enthusiasm of war, entered into temporary splendor which collapsed as the need and enthusiasm passed. When the peace of Paris was signed in 1783, the Virginian iron industry was probably no greater and no less than it had been in 1775; years were to elapse before it grew and achieved a notable influence. For this reason the iron industry in Virginia during the Revolution forms an interlude in the history of iron manufacture in the Commonwealth. Of the events of these war years I now wish to treat. But first let us glance at the stage on which the industry was set.

Gunnery Spring, Fredericksburg, Va.

Here stood the Government Gun Factory built and operated by Fielding Lewis and Charles Dick. Tablet erected by The Sons of the American Revolution.

He who delves in Virginian history must quickly discover the four geologic regions which in the large sense divide without sundering the state. From the bays and inlets washing the Atlantic Coast to the falls of the Potomac, the Rappahannock, the James, the Appomattox, and the Roanoke rivers, the country is known as Tidewater. Here the colonists found iron ore; but what they mined was a variety which we now know to have been a deposit termed bog ore. From the falls, where the rivers for a brief distance become noisy rushing torrents dashing over upheaved rock, to well within the spurs of the eastern mountain chain spreads an undulating area called the Piedmont. Below the geologic curvature, separating Tidewater and Piedmont, the great rivers rise and fall with the tides; above all the streams rise and fall with the great storms. It was the falls affording immense machine power, which determined the nineteenth century manufacturing importance of Richmond. A trough spoken of as the Great Valley, or merely the Valley, runs between two mountain walls that extend the whole length of the state, nearly three hundred miles from Maryland to Tennessee and North Carolina. The Great Valley is itself subdivided into the Valley of the Shenandoah and parts of the valleys of the James, the Roanoke, the New and the Holsten rivers. The fourth division is trans-Alleghany and includes the counties or section of counties which fall between the crest of the western wall of mountains and the state of West Virginia. In Virginia men speak also of Middle Virginia, of the Southside (the district below James river), of Southwest Virginia. Having no geologic foundation to distinguish them, these divisions lack the significance of the four grand divisions, Tidewater, Piedmont, the Valley, and trans-Allegheny. The geologic divisions long ago recognized in the fundamental law of the state and for generations common parlance, serve as scenes in the staging of the Virginian iron

*Documentary authority for every essential fact stated in this paper may be found in my unprinted manuscript *The Iron Industry in Virginia before 1865* . . . . , in the Radcliff College Library, Cambridge, Massachusetts.

industry. All but trans-Allegheny had their part in the manufacture of Virginian ordnance during the war of the American Revolution, and to them by their geologic names I shall make constant reference.

In August, 1774, there assembled at Williamsburg the colonial capitol in Tidewater, the first of the famous series of Virginian Revolutionary Conventions. But it was not until a second convention met on March 20, 1775, at The Falls of James River perhaps to escape the eye of the royal governor, perhaps for the convenience of the Piedmont and Valley delegates, that the members began to organize their material resources. And who were these rebel members? The men who made up the Virginian conventions in this period called the interregnum, were generally lawyers or planters who knew little of industry and while peace reigned cared less. George Washington was the son and the brother of former members of the Principio Company, an English venture in iron works in Maryland at the head of Chesapeake Bay. About the time the hero was born at Wakefield, Westmoreland County, Virginia, his father was blasting ore on one of the family plantations in Stafford County and carting it two miles to Accokeek Furnace which the Principio Company had erected on his property within six miles of the Potomac River. The elder Washington willed his mining interests to his son Lawrence; and Lawrence, who died young, left as heirs to his estate in the Principio, Accokeek, Kingsbury, Laconshire, and North East iron works in Virginia and Maryland, his daughter Sarah, or, if she died childless, his brother Augustine and his heirs. Possibly by 1775, George, the surveyor, knew of iron ore upon his own land. Be this as it may, I have found in the Revolutionary conventions only two persons who had engaged actively in the business of iron making. Isaac Zane, the immigrant from Pennsylvania, now the proprietor of the successful Marlborough Iron Works and three thousand acres of land in the Shenandoah Valley, probably crossed the mountains in the muddiest time of the year to take his place in the March convention. And Archibald Cary, the planter, was there, having come from his seat Ampthill, at Falling Creek, about eight miles below Richmond. Ten or fifteen years earlier the planter had failed in an attempt to revive the iron industry at Falling Creek, the site in Tidewater of the furnaces of the Southhampton Adventurers, whose project for manufacturing iron was so tragically ended by the Indian massacre of 1622. But lack of experience formed no obstacle to the delegates in evolving their new policy. When the planters and lawyers again assembled at the Falls, in July, 1775, they boldly set out by their own authority to build up an iron industry in the colony.

Thus with ears ringing with the sound of the shot fired at Concord in April, the delegates ordained that a manufactory of small arms should be established at Fredericksburg; ordered the treasurer to pay out twenty-five hundred pounds, and such other sums as the Committee of Safety should from time to time direct; and picked out half a dozen gentlemen any three of whom might be chosen to act as commissioners for building and managing the factory. In August they defied the act of Parliament which prevented the erection of plating and slitting mills in America, and promised to requite all loses that the proprietors of the first two plating and slitting mills, finished and set to work in Virginia, might sustain by any attempt of the British ministry to enforce the act. In December they required the Committee of Safety to contract with gunsmiths or others for manufacturing or supplying the colony with arms. In the following May the new house in possession of the capitol at Williamsburg acted with no less energy, until in June the convention dissolved forever and Virginia ceased to be a colony. Succeeding legislatures of the new Commonwealth trod the path marked out by the conventions. They, too, were pursuing a generous policy when outside demands and a mad currency ended the war-provoked interest in the Virginian iron industry.

Although the ordinance called for the appointment of three commissioners, only two engaged in erecting and and managing the first government owned factory in Virginia. One of these was Fielding Lewis whose family was probably as ancient and honorable as the Washington family for which he showed a strong predilection. A younger son in a land which still recognized the law of primogeniture and entail he left his ancestral estate, Warren Hall, in Gloucester County, and went in his youth to seek his fortune in Fredericksburg. In 1746 he married Catherine Washington, and after her death he won in 1750 her first cousin, seventeen year old Betty, the only sister of the almost equally youthful George Washington. With her he lived an active and a distinguished life in the historic house Kenmore in Fredericksburg until shortly before his death when the family removed from the town.

As years passed this member of the Virginian aristocracy became a most successful business man. With money from the sale of his Tidewater estates and from his town lots (some of which his brother-in-law, the future President, surveyed for him), he invested in cheaper land in the Shenandoah Valley, purchased ten thousand acres in Kentucky, and took a share in the Dismal Swamp Company and other ventures. Undoubtedly for financial influence as well as for his notable scrupulous exactness the gentlemen of the Convention made Fielding Lewis Commissioner.

His colleague was Charles Dick, one of a larger number of Virginians than is commonly suspected who before 1860 combined social prestige with a mercantile occupation. Inspect the titles of his library which included volumes of law, political theory, geography, travel, theology, novels, essays, poetry, drama, and books on husbandry and gardening and one gains insight into the personality of this vigorous but little known Virginian. Like Lewis he served on the fiery local revolutionary Committees, had connections with the Washington family, and bore apparently a reputation for practical ability. Besides conducting his private business he had acted as Commissary under Governor Dinwiddie. Thus no doubt for his organizing powers and his patriotism, he was chosen commissioner of the government gun factory.

Why the convention selected Fredericksburg as the seat of the enterprise, one lacking definite information can scarcely say. Virginians are generally influenced by the human elements in their transactions; the legislators thought that Fielding Lewis and Charles Dick would make very fit commissioners, and both lived at Fredericksburg. But apart from these eligible citizens, it is possible that the town offered other advantages. The port of Fredericksburg, situated on the Rappahannock River at the edge of

Kenmore, Fredericksburg, Va.—Home of Col. Fielding Lewis
Colonel Lewis and Charles Dick were appointed by the Second Virginia Revolutionary Convention Commissioners to build and operate an arsenal for the manufacture of small arms, July, 1775.

Tidewater, drew iron supplies down Chesapeake Bay from the contiguous colony of Maryland where the iron industry now flourished. Hunter's iron works of which we shall hear more later were already in 1776 a considerable establishment and but a short distance from the town. Therefore they might be expected to assist in furnishing materials. But further still, Fredericksburg lay in a section where the Spotswood furnaces had flourished for nearly half a century. Perhaps the legislators thought the commissioners would find around Fredericksburg persons who inherited industrial skill.

The commissioners bought two acres of land on the outskirts of the town and built a factory upon it. They rented an old mill on ground adjoining the government property, and equipped it for grinding new gun barrels, ramrods, bayonets, and files, thereby saving much manual labor. They made a contract for a stone magazine to be erected close to the factory. In all these preparations the two commissioners worked together; but when in eighteen months from the passage of the ordinance the establishment was ready for the business that was to be conducted in it, Fielding Lewis left his colleague to manage it, although he went on serving as financial director.

Corner of the Great Room at Kenmore with Portrait of Col. Fielding Lewis

Dick now became the spirit of the factory. He procured a master workman and assembled artisans, many of whom had to learn the craft of gun making. Possibly this was disheartening, for the manager lamented that the master workman was obliged to teach clumsy youngsters; and since he also had to issue tools and materials and even the provisions which the household consumed, it was only when he was at leisure, as Dick quaintly remarked, that the most valuable man in the factory could work.

One can see that the gentleman director, as he says, made his household live by tedious rule with an eye ever to the economy of the state. He forbade them beer and rum, a radical reform to introduce among eighteenth century iron workers in Virginia. Possibly in an effort to help pay expenses he and Lewis had purposely set the factory in a spacious garden where vegetables might be grown. Here at a noble spring the workmen slacked their thirst and lived the temperate orderly life of well disciplined school boys. Summoned to breakfast and to

dinner by the ringing of a bell, "the large family" sat down together at table to eat sometimes only greens and roots from their garden; and the meal finished, all with the eye of a kind but determined patriarch watching them, returned immediately to their work.

When he drew up a budget in 1782 for the governor of the Commonwealth, Dick listed in addition to one master workman, three common negroes to cook, bake, fetch, "go to mill," or do similar jobs, and thirty workmen. But on another occasion he stated, that from twenty to forty workmen might be well employed. Apparently, he understood the principle of the division of labor, for he encouraged piece work wherever it could be performed, both for economy and as a spur to the workman. Scourers of gun barrels, repairers of muskets, repairers of arms, and mounters of guns, as well as the higher grade artisans like musket stockers and lock filers pursued their special work. With the smaller articles ready forged, a good stocker would do his musket and a lock filer his lock a day, and without interruption and with sufficient funds, one hundred stand of arms could be turned out a month. To secure greater dispatch the men made their own machinery and tools for fashioning the "compleate" muskets and bayonets. Dick doubtless had good evidence for the statement, that his product "made from the ruff materials" was superior to most imported. At any rate, though consuming annually but eight hundred feet of two-and-one-half-inch walnut plank for gun stocks, two thousand bushels of coal, a ton of iron and five thousand pounds of steel, this little factory patched large numbers of old arms in addition to producing new muskets and bayonets.

"It is amazing," wrote Dick to Governor Jefferson in the spring of 1781, "the quantity of arms old and new that have been drawn from this Place since January last."

In an emergency the aristocrats of the town, women as well as men, became munition makers by entering the factory and stuffing twenty thousand cartridges, which with more than one hundred guns the manager hastily turned over to the Fredericksburg and the Spotsylvania militia.

As anticipated, iron, steel, walnut plank, and fuel were easily procured from the neighborhood, and there was at the factory no real lack of these articles so long as the government would pay for them. But in spite of the earlier iron manufacture of the region, and of the militia act, which exempted from military service persons concerned in iron works or employed solely in the manufacture of firearms, the manager of the new factory suffered almost immediately for lack of trained labor. "It is not the quantity but the Goodness of the workmen that is necessary to do Business to advantage," wailed Charles Dick in 1782, although in 1777 the House of Delegates had come to his aid and passed an apprentice act, which aimed to build up a class of trained artisans by admitting into the factory white youths who were to be schooled there. Until their term of apprenticeship ended, the lads were to devote their services to the benefit of the state while the state fed, housed and clothed them and dismissed them ultimately with a sum not exceeding thirty pounds.

Disciplinarian as he undoubtedly was, Dick had no difficulty in keeping artisans so long as the government provided him with funds. With one or more private small arms factories competing against him, he worked out his own scheme of economy, which was to secure an advantage by lower but always promptly paid wages, and for a time he maintained it. But what state official could attain complete success when the treasury was full of unpaid warrants, when the currency was not worth five hundred to one, and when the state dallied even to forward to him its worthless paper? It is evident that, beginning in 1781, work at the government factory had to be curtailed. "My credit, Word, Honour and everything mortal can do will not hold out longer with the people unless I am supported with money," Dick wrote Governor Jeffereson in the spring of 1781. His personal credit "pawned" and no longer able "to keep the tradesmen in temper," he closed the factory for a month during the summer in 1781. In the fall he wrote:

"I shall do all in my power to carry on the work; but impossibilities I cannot do; this Egyptian way [of making bricks without straw?] will not last."

He needed much "real money" to lay in stores and pay his men. By 1782 his force had disbanded, although some of the workmen, he believed, would yet trust him for most of their wages could they be victualled as usual, and he could call them in at any time. During the next few months provisions were plentiful around Fredericksburg, but Dick had no funds. The times were "more fit for an eternal veil than a bare Relation of the Causes," the manager wrote. Still hope sprang again in his breast upon the appointment or election of some new political officer, who, he believed, might inspire public confidence to the extent of restoring "an almost forever lost public credit, the soul of a Commonwealth." By the end of June he had "made a tolerable beginning." In July he had nineteen hands and five apprentices at work, and expected to draw more from the harvest field; but on July 16, he had scarcely two days' supply of food and no money.

Every committee which reported to the House of Delegates upon the accounts of the factory found them to be fairly and justly reported. But the committees failed to state the amount of capital invested in land, buildings, and tools, and as no account books have ever been found it is impossible to reach an accurate conclusion concerning the finances of the business. Since, however, each report announced the annual profit, it seems fair to infer, irrespective of Dick's own statement, that affairs were well run. By discipline, economy, and the aid of a faithful and intelligent master workman he had built up a successful business, which, provided he were supplied with necessary materials and funds for prompt wage payments, he thought he could expand to any extent. But public interest flagged. No longer spurred to create the procurement of war, what need was there for an arms manufactory? The executive requested the director to supply an estimate of one year's expenses; Dick, in love with his work and ever zealous to serve the state, hastened to comply. No future policy, however, grew out of it. The manager's "Proposals" made in December 1782 "for rehabilitating the great work" were refused, and in the following May the assembly passed an act vesting the gun factory and the lands pertaining thereto in trustees, who should found an academy for the instruction of young Virginians.

A true estimate of the high patriotism of Fielding Lewis

and Charles Dick is more nearly reached if it be recalled that the House of Delegates, with more thrift than justice, borrowed heavily from Lewis, permitted the debt to run for years, and allowed the two men for their services at the arms factory ten shillings each day, while they voted John Reveley, the manager of the Westham foundry near Richmond, twenty shillings a day. As long as the money equalled in value either gold or silver as in 1776, and indeed until active depreciation set in about 1778, Lewis and Dick accepted their respective annual salaries of one hundred and eighty pounds. But when the legislators in 1778 increased the yearly pay of each commissioner to three hundred pounds, a sum worth only fifty-four pounds, and in 1779 to one thousand pounds, worth forty-three pounds, and in order to run the factory contrived to borrow from Fielding Lewis and to exploit Charles Dick's personal credit, the commissioners felt their patriotism strained to the breaking point. Galled by ingratitude, cramped for a bare living, and privately considering that he and Lewis had been cheated out of two years' services for which they possessed no redress, Dick at the end of 1780, or early in 1781, sent his resignation to the governor. But Jefferson refused to accept it, and reappointed him director of the factory. Financial amends to this industrious public servant may have been attempted, yet on September 12, 1782, Dick could not draw a salary already two years in arrears, because someone had omitted to enter his name upon the civil list included in the appropriation act. There is no reason, however, to believe that he failed to secure it ultimately.

Home of Charles Dick, Commissioner of the Small Arms Manufactory at Fredericksburg, Va., during the American Revolution

Lewis, on the other hand—having played his part manfully, having procured for the adventure between thirty thousand and forty thousand pounds, of which he took seven thousand out of his now slim purse, so that the state, failing to reimburse him, he could not at the beginning of 1781 even pay his taxes—was forced to curtail his private business, and, distressed by financial cares, lost his health. Possibly feeling death upon him he made his will, as it happened, on the day of the great victory at Yorktown, and died soon thereafter. In a letter which General Washington wrote from Newburg, April 17, 1782, to his sister's stepson, John Lewis, the son of Colonel Fielding Lewis, the general lamented the recent death of the young man's father. He was also deeply concerned at his brother-in-law's having died heavily in debt.

Colonel Lewis's letter, which he wrote in February, 1781, to a Virginian state official, describing the financial responsibilities he had assumed in order that the gun factory might be carried on, is for all its proud manliness full of pathos. His high patriotism, and its abuse by the legislators, is probably typical of what was happening in the other American commonwealths. Such cases no doubt served to hasten the political reaction that culminated in the adoption of the strong Federal Constitution.

Without Colonel Lewis's financial assistance the business of the arms factory probably could not have continued. Yet it is Dick, the director of the factory, whom our future historians will chiefly associate with its brief, but valuable career. Ardent, fearless, vigorous, upright, tactful, serious; conscious of his abilities, but wholly lacking in conceit; scornful of "a maccaroni" who fails in his trust: "I . . . shall never trouble such creatures again but to catch Butterflys," he declared. Expressing himself from time to time in pregnant phrase, that fastens upon the imaginative memory, Charles Dick, in the extant fragments of the correspondence that the exigencies of the period demanded he should carry on with government authorities, has perpetuated himself with the charm of the eighteenth century letter writer and proved that a Virginian merchant belonging to the governing class with no previous industrial training could take hold of an industrial problem and profitably solve it.

In May, 1776, when the government factory at Fredericksburg was well launched, two men, lacking the solid political, financial, and social influence of Fielding Lewis and Charles Dick, but claiming knowledge of various branches of the iron business, stepped forward and, on the ground of the colony's need for ordnance, petitioned the convention to aid them in establishing iron works. These men were John Ballendine and John Reveley.

John Ballendine's name was known to the most prominent men of his day in Virginia and Maryland—men who possibly at different periods regarded him with varying opinions. Of a Lancaster family, says Mr. Fairfax Harrison in his recent *Landmarks of Old Prince William*, John Ballendine may have been a descendant of that Liverpool shipmaster whom "King" Carter's letter book shows to have been trading in the Rappahannock for eight years immediately following 1722. At any rate whether born in America or drifted from England he also took to the water and for fourteen years transported merchandise up and down the Potomac River, before he initiated and for a brief period ran an iron industry on the Occoquan. This business based on contracts made in 1755 with the Peytons and the Ewells, and on a partnership which he formed with John Taylor the second and Presley

Thornton then operating Neapsco Furnace, in four years included an iron furnace and forge, two saw mills, and a bolting mill. But to erect them Ballendine apparently mortgaged everything he had including his soul. "Directed an Indictment to be formed by Mr. Johnston against John Ballendine for a fraud in some iron he sold me," wrote George Washington in his diary on January 8, 1760, with his usual precision. In 1760 the Ballendine-Taylor-Thornton partnership expired by limitation and the Neapsco partners withdrew. Ballendine, thus left alone to sink or swim, borrowed more money, was forced to transfer all his interest in the works to his Maryland creditor, and left with only the superintendence of the works and a share in the profits—probably because under his management there were no profits—was himself in 1765 ejected from the business which the owner soon abandoned to run exclusively the very profitable Occoquan flour mills. The instance is typical. No single place or occupation could encompass John Ballendine or his unsuccessful schemes.

He next turned to building a dam in a channel of the Potomac River at Seneca Falls in order that he might carry on some sort of mill of his own, and becoming possessed with the idea that had fastened upon men's minds of extending the inland navigation of the great rivers of Virginia, he shrewdly set out to capitalize it. For a time he bewitched prominent gentlemen into accepting his estimate of his powers. In May, 1772, a number of them gave him subscriptions and weighty testimonials of confidence in his integrity and ability, so that he might carry out his plan, which was to raise subscriptions to enable him to go to England to study the science of canal building; to procure additional subscriptions in England for constructing the canals; and to bring back skilled artisans to accomplish the great works under his direction. He crossed the sea and in 1774 he returned with his men to America.

The Virginia and the Maryland trustees named in his proposals for making navigable the Potomac River received him favorably. Johnson of Maryland, Washington of Virginia, and others subscribed substantial sums, but he was unable to carry through his project. And having publicly announced that the Maryland assembly had refused at present to pass an act cooperating with the act of the Virginian burgesses for opening the Potomac to inland navigation, he went to Richmond, bought fifty acres of land up James River about six miles from the town, and, according to Thomas Jefferson, without authority from either the Virginia assembly or a Virginian court of law, built a dam across an arm of the river, drew off fifty feet of water, and proceeded to construct a canal. While he was engaged in the work, the battle of Concord was fought, one of the consequences of which no doubt was to cause Ballendine to unite with John Reveley in a scheme to mine and manufacture iron.

Woe for John Reveley when he joined his fortunes with those of John Ballendine! Of more sober temperament, Reverley was well trained in the technicalities of the iron business as his later work for the Virginian war government showed. I have not been able so far to discover where he came from or whether he had been long in America. No doubt like Ballendine he was bent on making a fortune. Neither of the two appears to have possessed any capital, and Reveley seized the opportunity which the colony's need for munitions offered to the trained and industrious iron worker. So sure were both he and Ballendine of government aid that they jointly contracted in the Piedmont county of Buckingham for what they considered valuable iron and coal mines which lay close to James River. Here they intended to build and conduct extensive iron works, provided they could get money aid, and with this in view they petitioned the convention for funds.

The convention referred the petition to the Committee on Propositions and Grievances, who possibly had their own ideas on the subject of Ballendine. They advised the House at once to build and conduct on government account a foundry to provide the colony with cannon. To the petitioners, John Ballendine and John Reveley, the committee recommended the delegates to advance under certain stipulations a sum not exceeding five thousand pounds, to enable them to erect a blast furnace to supply the foundry with pig iron. The convention accepted the committee's advice both in regard to a cannon foundry and a blast furnace, and devoting, immediately, five thousand pounds to be advanced by trustees to John Ballendine and John Reveley in such installments and at such times as the trustees judged necessary to enable the petitioners to buy lands and build and carry on a blast furnace, appointed two days later, Richard Adams, Nathaniel Wilkinson, and Turner Southall, Esquires, commissioners for erecting a government foundry, known to history as the Westham foundry, near Richmond. The petitioners on their part accepted the decision. They promised to furnish the foundry at seven pounds ten shillings currency the ton, all the pig iron they could make, and to return in five equal payments the five thousand pounds advanced to them. For security they gave the lands which they should purchase and the works which they should build thereon. As Jefferson said, the loan, indeed, amounted to a contract to pay the Commonwealth 666⅔ tons of pig iron.

The commissioners who had been given freedom to choose whom they pleased to erect the foundry, and the purse of the colony to carry out the scheme, were men with doubtless executive but no industrial experience. And so perhaps naturally they turned to the petitioners. From Ballendine they purchased on the north side of James River a mile below the little town of Westham, three and a half acres of land; the privilege of free navigation on an adjacent canal, which for a year or more he had been building between Westham and Richmond; and the right to draw from the canal all the water necessary to turn the machinery of the government mills. The site chosen was not far from active bituminous coal mines, which would furnish the "pit coal" considered necessary to the manufacture of cannon. John Reveley, the commissioners appointed constructor and future manager of the iron works. They gave John Ballendine no part in the construction or management of Westham foundry; but by depending upon his canal for water power, and by selecting as manager of the foundry John Reveley, his partner, they spun out the entanglement which had already crept between John Ballendine and the state over the building of a canal authorized by the House of Burgesses in 1764. For since

Ballendine and Reveley were partners in the Buckingham furnace, which became heavily indebted to the state, and as Reveley in 1781 claimed that a part of his salary as manager of the foundry remained unpaid, the affairs of Ballendine, Reveley, and the Commonwealth became irrevocably mixed. But men capable of conducting iron works were not easily to be procured. Perhaps circumstances gave the commissioners no choice.

When in May actual labor began on the new government scheme there was, no doubt, among all concerned with initiating it, great satisfaction. John Reveley spent two hundred and forty-four days drawing drafts and superintending the building of a foundry with four double stacks, eight air furnaces, a boring mill, and other buildings including probably the magazine, the manager's dwelling, and cabins for the artisans. Five years later, Simcoe, an officer in the British army, pronounced foundry, furnaces, and mills very complete. A mile beyond the foundry and six miles from Richmond stood a laboratory where the Continental government made shells in collaboration with the state work going on at the foundry. While directing the building, Reveley or the commissioners seem to have put the construction of the foundry in the hands of a local builder. But Reveley himself journeyed to Fredericksburg, perhaps to secure labor as well as to inspect the Hunter mills, for he brought back a stone mason, whom he set to work with other workmen, white and black. The peculiar clay suitable for firebrick, because capable of standing great heat, was secured from the neighboring coal mines; for lining the furnaces, lime made out of oyster shells was brought from the bay; and work proceeded, lightened with an occasional drop of whiskey or of brandy. While the building was under way Reveley also gave lessons in melting iron and boring to both slaves and white men; but in November, 1778, it was solemnly announced in the House of Delegates, that the foundry now appeared to be complete and for want of proper workmen, the useful work was of no advantage to the state. Thus the members hastened to empower and provide the manager with funds to go in search of and employ not more than three men familiar with the method of casting cannon.

(*To be concluded in the January-February, 1927, issue of* ARMY ORDNANCE)

Ordnance Arsenals Pass Safety Inspection

A THOROUGH inspection of all Army arsenals, made under the direction of Maj. Gen. C. C. Williams, U. S. A., Chief of Ordnance, and recently completed, shows that conditions in regard to the storage of Army munitions is most satisfactory and that only minor changes are necessary to improve on the present system.

General Williams personally made some of the inspections which were commenced immediately following the explosion of the Naval ammunition depot at Lake Denmark, N. J., in order to determine whether any improvement could be made in the safety devices to prevent fires and explosions in buildings where ammunition is stored.

The results of the inspections made are to the great credit of the Ordnance Department, for it was found that the regulations regarding the storage of explosives have been carefully observed. Only some minor changes and improvements were found necessary.

As an example of the recommendations made for improvement in safety measures, it was ordered that vegetation be cleared away for fifty feet around each magazine, that underbrush between buildings be cut away, and that electrical tests be made to insure that lightning rods were grounded.

Due to the safety precautions which have been in vogue at Army arsenals, these have been exceptionally immune from explosions and fire.

An inspection of safety devices was made personally by Commanding Officers of all arsenals, immediately following the Lake Denmark disaster. They were required to make a report to the Chief of Ordnance as to the safety devices used, together with recommendations for improving safety conditions. These reports have all been received and in general show that safety conditions are excellent. Some minor corrections necessary in some cases will be put into effect.

A representative of the Chief of Ordnance inspected the proving grounds at Erie, Ohio; Savannah, Ohio; the Ogden Arsenal, Utah; Benicia Arsenal, Calif., and Fort Wingate, New Mex. Conditions at these places were found to be generally satisfactory. Some rearrangements and changes in the storage of ammunition at Fort Wingate, however, have been made as a result of the inspection.

A board of Ordnance Officers inspected Curtis Bay and Raritan Arsenal, and as a result steps are being taken to reduce the amount of explosives stored at these places. The board also inspected at Pig Point, in connection with the burning of a building there, and it was found the safety precautions there very satisfactory.

Brig. Gen. J. W. Joyes, U. S. A., Assistant Chief of Ordnance, made a very thorough inspection in Hawaii, Philippines, and Panama, relative to the storage conditions of ammunition, and found them satisfactory in general. The inspections made by General Williams of depots, regarding safety devices, showed that these measures were being carefully carried out.

Officers and Directors of the Army Ordnance Association 1927-1928

AT THE election of officers and directors of the Army Ordnance Association held September 7, 1926, the following were elected:

President (January 1, 1927, to December 31, 1928)

Hon. Benedict Crowell, Cleveland, O.
Chairman, Crowell and Little Construction Co.

Vice-Presidents (January 1, 1927, to December 31, 1928)

Col. William W. Coleman, South Milwaukee, Wis.
President, Bucyrus Company

Brig. Gen. Guy E. Tripp, New York, N. Y.
Chairman, Westinghouse Electric and Manufacturing Co.

Directors (January 1, 1927, to December 31, 1930)

Brig. Gen. Samuel McRoberts, New York, N. Y.
Chairman, Chatham-Phenix Natl. Bank and Trust Co.

Waldo C. Bryant, Bridgeport, Conn.
President, Bryant Electric Company

Col. Wm. C. Spruance, Wilmington, Del.
Vice-President, E. I. duPont de Nemours & Co.

THE complete roster of officers and directors of the Association in addition to those elected as above is:

Directors (To serve until December 31, 1928)

Col. Robert P. Lamont, Chicago, Ill.
President, American Steel Foundries.

Col. Frank A. Scott, Cleveland, O.
President, Warner and Swasey Co.

Col. C. L. Harrison, Cincinnati, O.
Capitalist

Directors (representing local posts)

New York Post

Col. James L. Walsh, Ord. Res., New York, N. Y.
Bankers Trust Company

Boston Post

Col. Charles H. Tenney, Ord. Res., Boston, Mass.
President, Springfield Gas Light Co.

California Post

Col. Bruce Cornwall, Ord. Res., San Francisco, Calif.
Cornwall, Caldwell and Banker

Cincinnati Post

Casper H. Rowe, Cincinnati, O.
Director, Fifth-Third National Bank

Treasurer

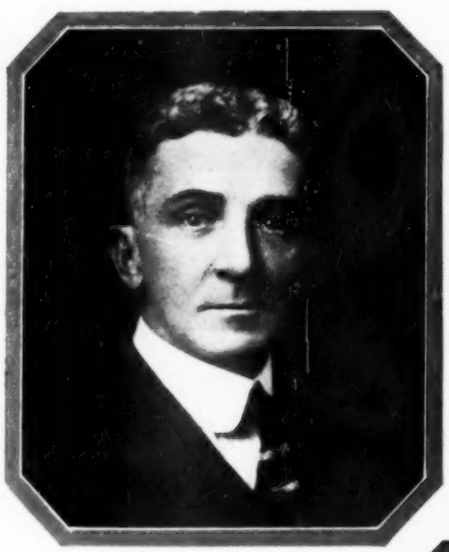
Col. Chas. Elliot Warren, C. A. Res., New York, N. Y.
Vice-President, Irving Bank and Trust Co.

Secretary

Maj. Chas. R. Baxter, Ord. Dept., U. S. A.
Washington, D. C.

Officers of the Army Ordnance Association
1927-1928

President
Benedict Crowell
Cleveland, O.

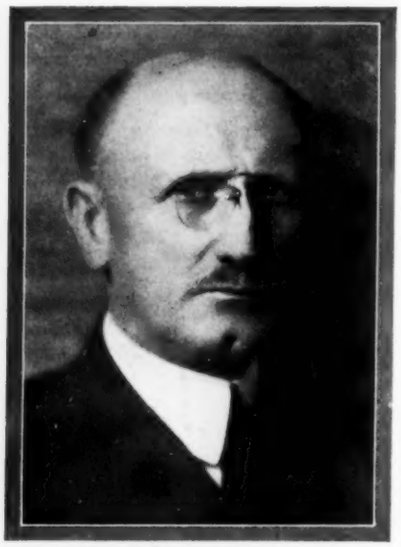


Vice-President
William W. Coleman
Milwaukee, Wis.

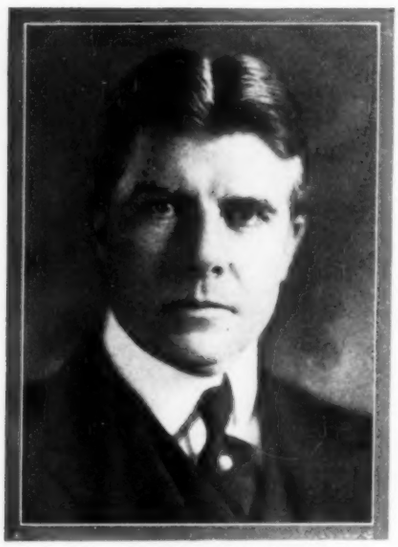
Vice-President
Guy E. Tripp
New York, N. Y.

Treasurer
Chas. Elliot Warren
New York, N. Y.

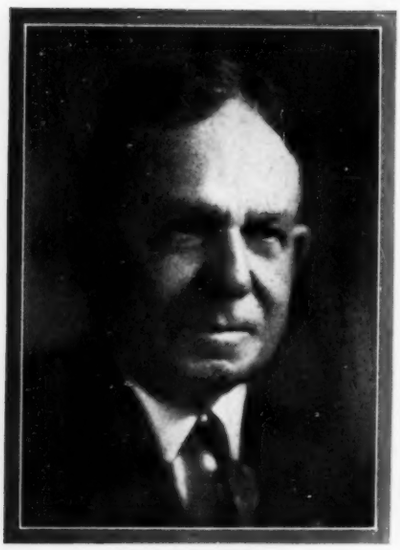
Directors of the Army Ordnance Association
1927-1928



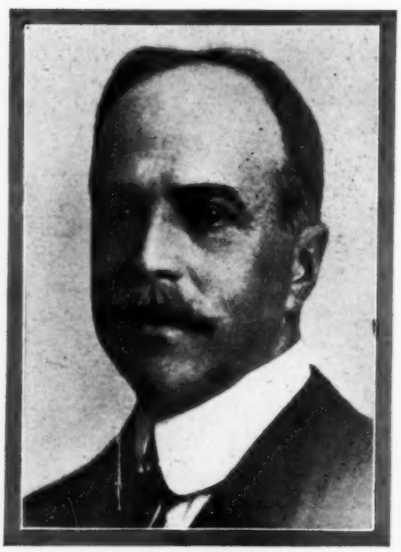
Robert P. Lamont
Chicago, Ill.



Frank A. Scott
Cleveland, O.



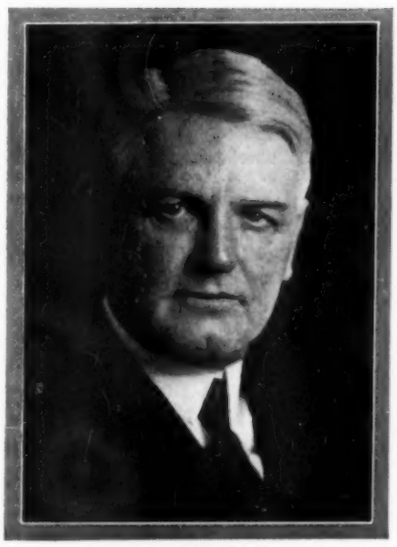
Charles H. Tenney
Boston, Mass.



Waldo C. Bryant
Bridgeport, Conn.

William C. Sprunance
Wilmington, Del.

Directors of the Army Ordnance Association
1927-1928



Samuel McRoberts
New York, N. Y.

Bruce Cornwall
San Francisco, Calif.

C. L. Harrison
Cincinnati, O.

James L. Walsh
New York, N. Y.

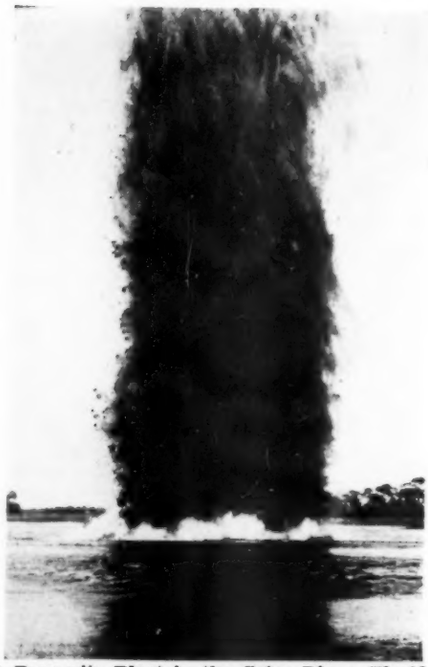
Casper H. Rowe
Cincinnati, O.

Commercial High Explosives

Arthur LaMotte

IS it claiming very much for commercial high explosives to say that industrial progress not exactly started with the production of dynamite in the United States, but certainly took a great leap forward at that time? Great engineering projects were undoubtedly accomplished prior to 1866—several good sized railroad tunnels and the Erie Canal—in which black powder, or gunpowder as it was known then, was used; and, of course, tunnels were driven by the ancient Romans before even gunpowder was invented. We have no record of the number of feet per month driven in the latter case where the work was entirely manual, but we do have records of tunnels driven partly with black powder and partly with dynamite and these show about three times the progress with dynamite that was obtained with black powder, in spite of the fact that the dynamite was then a new and untried agent and was by no means the last word on high explosives.

The first dynamite plant built in the United States was the California Powder Works on San Francisco Bay around 1867. They made at that time what we now call "guhr" dynamite—75 per cent. of nitroglycerin absorbed with 25 per cent. of Kieselguhr. Although much stronger than gunpowder, it had several disadvantages. It could be made in only one grade and one quickness. Its limitations led to experiments being made by adding nitroglycerin to gunpowder with the result that it was found that the combination of nitroglycerin and gunpowder was stronger than the sum of the two fired separately and permitted the making of several grades of strength. This was the beginning of the active base dynamites and the highly specialized dynamites of today. The ground charcoal in the gunpowder was replaced by wood pulp, having a much higher absorptive capacity for nitroglycerin than charcoal.



A Dynamite Blast in the Cotee River, Florida.

Nitrate of potash in the gunpowder was replaced by nitrate of soda as being much cheaper and equally effective as an oxygen carrier. The sulphur was dispensed with altogether as its function in black powder is to reduce the ignition point, and with nitroglycerin furnishing the sensitizing agent, it was not needed. In this mixture—nitroglycerin, nitrate of soda, and wood pulp—we have the basis of the vast number of formulas available today for commercial high explosives. Even with these three ingredients we can make explosives containing from 15 per cent. up to 60 per cent. of nitroglycerin.

It is interesting to note that nitroglycerin has remained the chief sensitizing ingredient for commercial high explosives whereas its use in propellants has been largely discontinued because thus far no way has been found of controlling its erosive effect upon a gun barrel.

Nobel's invention of Kieselguhr dynamite was followed shortly afterward by his invention of blasting gelatin—92 per cent. nitroglycerin and 8 per cent. nitrocotton. This latter forms a rubbery, semi-translucent substance somewhat resembling in consistency art gum or the material

Exterior of Nitroglycerin Neutralizing House, Dynamite Plant, Showing Barricades.

from which printers' inking rolls are made. It is generally considered the most powerful high explosive made, but it has disadvantages in that it is exceedingly sensitive when frozen, and is so elastic that it cannot be upset and expanded in a bore hole, especially an upper.

By using a relatively small amount of nitrocotton dissolved in nitroglycerin, a mucilaginous mass is made which, when incorporated with wood pulp and nitrate of soda in various proportions, forms the gelatin dynamite of today, the most popular of all commercial explosives. Gelatin dynamite can be made in strengths from 25 to 90 per cent., is plastic, sticks in the uppers, is very water resistant, and when made with regard to the proper oxygen balance (that is, incorporating enough oxygen carriers to burn to part of the nitrate of soda are replaced by nitrate of ammonia.

Still another class of high explosives, of which some fifty millions pounds are sold annually in the United States, is composed of the so-called permissibles. A permissible explosive is one which has passed the Bureau of Mines tests and which is designed for use in gaseous and dusty coal mines. There are several types of permissible explosives: one similar to the straight dynamite but containing an excess of carbonaceous material, designed to lower the height and duration of the flame; another consisting essentially of an ammonia dynamite, but having a very large percentage—70 to 80 per cent.—of nitrate of ammonia, and usually not more than 10 per cent. of

Typical Mixed Acid Storage Area of a Dynamite Plant.

CO_2 all the carbonaceous absorbents) gives off a minimum of poisonous gases when effectively confined. Gelatin dynamite does not attain its full velocity of detonation or quickness, as it is called, unless it is confined.

Ammonia dynamites, very close to the gelatin dynamites in popularity, consist essentially of the straight dynamite formula with approximately half of the nitroglycerin replaced by nitrate of ammonia. This class of dynamite used to be called "extra" dynamite. It is slower in action than the straight dynamite and like the straight dynamite develops its full velocity, or very nearly, under even moderate confinement. It gives off much less obnoxious fumes in close work than straight dynamite and is much less sensitive to handle.

A dynamite intermediate between gelatin and ammonia dynamites is also coming into use in considerable quantities at the present time, known as special gelatin. This is a gelatin dynamite in which part of the nitroglycerin and nitroglycerin, with or without small amounts of nitrate of soda and salt. Ammonia permissibles are by far the most popular, there being no less than 112 of this type of explosive on the permissible list when last published.

Another recent development in permissible explosives is a gelatin permissible, which has the plastic, water resistant and fumeless properties of the gelatin dynamites combined with the distinctive characteristics of a permissible. This combination of qualities makes a gelatin permissible a valuable addition to the list of coal mining explosives, especially for very wet work and for difficult rock blasting in the presence of gas or dust.

Nitrostarch is used in place of nitroglycerin as the sensitizing ingredient of several types of explosives, some of which have passed the test for permissibility. Their principal use, however, is in quarry operations, where they are popular on account of the fact that they do not cause

the characteristic nitrogyleerin headache when handling them. The disadvantage of nitrostarch powders is that they are not as dense as the gelatin dynamites and it is not possible to get as high a concentration of force in a given space.

Nitroglycerin explosives at the present time are made low freezing by the largest explosives manufacturers by a process involving the mixture of regular glycerin with polymerized glycerin. Polymerized glycerin is made by taking one molecule of H_2O from two molecules of glycerin. This has the advantage of lowering the freezing point of the dynamites to a point well below zero Fahrenheit, but has the disadvantage of making the nitroglycerin more viscous so that although it does not freeze, it becomes thick and the cartridges, when cold, are rather hard to prime. A recent development in explosives technique has overcome this drawback, however, and the manufacturers are now prepared to furnish high explosives which will not require thawing in any temperature encountered in the United States.

Not many years ago dynamite manufacturers were content to worry along on three types of dynamite—straight, gelatin and ammonia—each one running from four to six different strengths, and the consumer picked the type which came nearest to meeting his requirements. As consumption per unit of mine or quarry increased, however, and dynamite was bought to a large extent in carload quantities, it became feasible to modify the formula somewhat to meet various needs on the part of the customers. A special ammonia powder containing a small amount of nitroglycerin approaching the premissibles in formula, was developed for salt mining where no water was encountered and where it was desirable to avoid any stain on the salt. This explosive was not adapted for gypsum mining because these are generally very wet, and still a different formula had to be worked out for this class of work.

The big tunnel operations around New York, with the Catskill Aqueduct and Shandaken Tunnel contracts, called for immense quantities of explosives, the primary property of which was to be as free from noxious fumes as possible. A great deal of experimental work was carried on under these conditions which resulted in the formulation of a gelatin so balanced that the entire blasting work in the nineteen mile Shandaken Tunnel was accomplished without a complaint on the part of the contractor with regard to fumes. This necessitated the manufacture of a special paper for wrapping the gelatin in, in order to get the irreducible minimum of carbon monoxide and nitric oxide.

For iron mining two different types of explosives have been developed, one a free running granular explosive of low strength, containing small quantities of nitroglycerin and large proportions of nitrates and absorbents, used for moving the soft ores of northern Minnesota so that they can be handled by the large steam shovels; and a low grade gelatin, 25 per cent. strength, for the hard hematite ores where a maximum of explosive concentration and a minimum of cost is desired.

It has been found that while a perfectly balanced explosive, as regards having enough oxygen carrying material to convert all the carbon to CO_2, is desirable from a fume standpoint, greater strength can be had by the use of an unbalanced formula giving considerably more carbon monoxide gas than could be tolerated in close work. Therefore, for open work where CO is not dangerous, an explosive of this type, known as quarry gelatin, has been developed which gives the maximum amount of disruptive force at a minimum cost. Low grade gelatins are likewise popular in gold and silver mines where there is considerable loss in the metal values if the material is shot too fine.

In tunneling, the highest strength possible with the minimum of fumes is necessary, and the 60 per cent. gelatin dynamites are in almost universal use for this class.

In submarine blasting, such as harbor excavation, canal deepening, and deepening and widening channels, the strongest possible explosive, regardless of anything else, is needed, and a 90 per cent. gelatin is the explosive most in demand for this class of work.

Dynamite of a high degree of sensitiveness, such as 60 per cent. straight, is used in blasting where a number of charges placed close together are fired simultaneously by the detonation of one charge, usually in the middle. The explosion of this is communicated to adjacent charges, which, in turn, pass it on. This is called the propagation method when used for blasting ditches, and range firing when used in submarine blasting. This obviates the necessity of the rather complicated system of wiring required by the method where each charge is primed with an electric detonator. The blasting of ditches in swampy and wet soils is done in this way, and about 800 miles of ditches have been blasted in the United States for farm drainage, malaria control and land reclamation.

The manufacture of dynamite is largely a matter of quantity production, chemical control of numerous raw ingredients and of manufacturing processes, and continued safety precautions. Over three hundred million pounds are sold each year in the United States. Dynamite manufacture requires experienced judgment, reliability and unceasing vigilance on the part of the workmen, but not the high degree of specialized skill necessary for the making of propellants. The manufacture of propellants does not require large quantity production except in time of war, nor chemical control of many ingredients, but it does require the greatest skill on the part of the workmen—different kinds of skill for different processes and of such a nature that it could not very well be developed outside of a smokeless powder plant. Competent operators in smokeless powder manufacture are true craftsmen, and like true craftsmen require constant practice to acquire and retain perfection in their craft. The problem of the manufacturer of propellants, therefore, is how to be prepared at the outbreak of war for the large scale production immediately necessary. Dynamite plants can not be converted into smokeless powder plants to met the emergency for two reasons: first, the equipment and the processes of manufacture, the ingredients employed for the two types of explosives, and the kinds of personnel required are entirely different; second, dynamite itself is essential for the production of iron, zinc, copper, vanadium and other metals, coal and stone in the immense quantities needed at such a time and consequently its manufacture must be carried on without interruption. Dynamite is at all times a basic material for the country's most important industries and therefore its manufacture and uses may well be a subject of interest to officers of the Army not only, but to the industrial executives and engineers of the Army Ordnance Association as well.

Romance Gives Way to Efficiency

The Cross-Country Car at Fort Benning, Ga.

Maj. Stephen A. MacGregor, Ord. Dept. U. S. A.

FROM time to time since the close of the World War articles have appeared describing many improvements and innovations in design of war material. Progress has been rapid and of far reaching effect. Armies of comparatively few years ago would scarcely recognize their up-to-date successors. Not only have improvements been made in existing matériel, but new devices have appeared and new methods have been developed.

It is not to be contended that all progress has been due to the World War but certainly that conflict has served to direct attention to war material and to bring into the field of development many minds which might have continued along lines more closely defined. The arts and sciences which have combined to give us new things in every day life, the engineering skill and ability of those who strive to bring to us the conveniences and more efficient appliances of modern invention, all have been enlisted in the work of application to war machinery. Whether the World War was a "special" war—a particular conflict which might be conceived of only under special conditions—whether such a war will happen again or whether it can happen again are questions not to be discussed in this article. The facts handed down as gathered from that titanic struggle constitute the maxims of today. The difficulties as experienced in Europe, the conditions under which troops fought and manoeuvered and were transported, the tactics and strategies of the opposing forces, the employment of weapons and the methods of supply and communication all compose the latest chapter written on the science of war.

In this chapter we find many things to indicate the necessity for improved methods. We find ourselves thinking in terms of larger forces, of greater areas and of increased ranges. We find the radio outstripping the telegraph which in its turn had outstepped the messenger. We find the motor truck, the tractor and the automobile replacing animal-drawn transportation, and we find the tank reviving the olden day armored knight but providing for him a gasoline horse.

It might be said that the hero of the battle of the future will not only smell of powder and smoke but will also reek of gasoline, for in such a battle airplanes, trucks, tanks, tractors and automobiles will be important items. The odor of gasoline fumes will challenge the odor of burning powder and although we cannot now sing of gasoline in as romantic notes as the war-time song writer composes to the poetic shot and shell, who knows but that future bards may so train their nostrils as to thrill at the wake of a passing "flivver".

But, what with increased range of weapons, airplane reconnaissance, and radio transmitted information, transportation must needs keep pace. It is a long jump from the time when a lone horseman could gallop through the country-side spreading the alarm of an approaching enemy. Even though less romantic, the modern messenger prefers an automobile. This increase of the prosaic is no doubt unfortunate but the march of progress and the urge of efficiency must be felt. War is now a business,—a very morbid sort of business, perhaps, but withal a business which must, like all well organized enterprises, be rendered efficient. Unlike other business, it seems to be free from the fear of being discontinued because of inefficiency.

However, we must see requirements as they confront us. Among other needs of present day military equipment is the need of speedy dependable transportation. This applies to troops, ammunition and supplies. One item of this rather broad subject of transportation pertains chiefly to the question of local reconnaissance.

An urgent need has been voiced for some sort of light transportation for unit commanders which may be depended upon to travel with troops even to advanced points. The cross-country car which has been experimented with is really a reconnaissance car but has avoided that name because of possible confusion with an entirely different type car used during the War and which was called a reconnaissance or staff observation car.

As contemplated, the cross-country car will be available for commanders of units down to regiments, or smaller provisional forces acting alone. Some requirements may be laid down as fundamentally necessary.

The car must be able to negotiate good or bad roads and, to the greatest practicable degree, cross-country territory.

It must be as light as consistent with strength to resist fairly rough usage.

It should be of commercial make, if practicable, without any unnecessary refinements or equipment.

To be of use as contemplated the first requirement above must be fulfilled. The commander must be able to travel to all parts of his line quickly. He should be able to leave his command to investigate possible positions ahead or at some point off the line of march and this investigation must be practicable of completion without delay to the column. The many other uses of a cross-country vehicle need not be mentioned. The need is assured, the problem is to supply this need.

The car must be light. In its use cross country and off roads many occasions may be expected where the car will be stuck. A light car is more easily extricated from a difficulty, even being lifted or pushed by the occupants. At the same time weaknesses of construction must be avoided.

The advantages of using a commercial make car are of course obvious. Procurement in quantity and repair and maintenance are simplified when special apparatus is avoided.

Two types of cross-country cars have been sent by the Ordnance Department to Fort Benning, Ga., for test by

How the Infantry Board Tests the

Puzzle Picture—Find the Road.

A Hard Right Uphill Turn with 100-foot Drop over Ledge at Left.

The Car is Led to Water but, as it Splashes through, the Passengers are made to Drink.

Rear Wheels down between Logs of a Bridge, but the Car is Light and is easily lifted.

Cross-Country Car at Ft. Benning, Ga.

Ready for a "Mean" Slide.

Demonstrating an Uphill Crawl out of a Wandering Woodland Stream.

Just before the Dip—not much left but the "Immelman Turn."

Brakes are Necessary and, as this View shows, they must be Efficient.

the Infantry Board. Possibly a better place could not have been selected to test the merits and possibilities of these vehicles. The reservation of 97,000 acres offers a wide variety of terrain. From concrete roads to virgin forests, from dry sandy stretches to wet boggy mud holes and from open plains to wooded hills, every condition is presented. Portions of the reservation are ordinarily inaccessible except on foot or horseback and these are so remote as to be out of reach on a one day trip. There are many streams and small lakes which offer an assortment of difficulties ranging from an ordinary wet spot to a river crossing.

Through these virgin forests, over the mud holes and across the bogs the cross-country cars sent for test have been operated for some time with remarkable success. The cars have been in daily use by members of the Infantry Board and of the Academic Department Staff. The accompanying illustrations are reproduced from photographs taken on a test trip over what is known at Benning as the Upatoi trail. This trail is a bridle trail, blazed through the woods by a tank battalion. It winds along the Upatoi Creek, skirting the edges of steep ravines in places and sounding the bottoms of narrow wet gullies in others.

For years this bit of virgin woodland has hidden itself from the sights and sounds of modern progress and invention. Its secrets could not be kept, however, and the bridle trail was opened up, not without great difficulty. Even so, it was only to the horseman or the most enthusiastic of trampers that the opportunity was presented to roam through this beauty spot. The ordinary automobile could not be taken safely over the trail, either because of real danger of serious accident or because wise precaution prohibited risking damage to the machine.

The cross-country car, however, negotiates such terrain with little difficulty. Not only is it possible to travel the trail, but when necessity demands the car is taken off the trail, through underbrush or rough country, and around obstacles or dangerous places.

It is not the purpose of this article to discuss the details of the car or to suggest definite uses to which it may be put. The Infantry Board is not yet prepared to recommend a definite distribution of cars through the Army organization. So far, observation has been limited to the performance of the vehicles under various conditions. One point seems clearly defined, that is, that the cross-country car fills a decided need. It has come to stay, and so firm is this idea that among those who have operated the car and who have depended upon it at times when other transportation failed, the question arises, "What did we do befor we had this means of getting about?"

The answer is that the "getting about" was not done—nor was it as necessary then as it is now. Things have changed somewhat. The present day commander can not depend upon anything but wide and thorough reconnaissance. He is playing a bigger game, a game of broader dimensions than ever before. The older methods prove quite inadequate. Reconnaissance of the immediate vicinity is insufficient. Foot troops can cover only a limited area and can cover it thoroughly only if sufficient time is allowed.

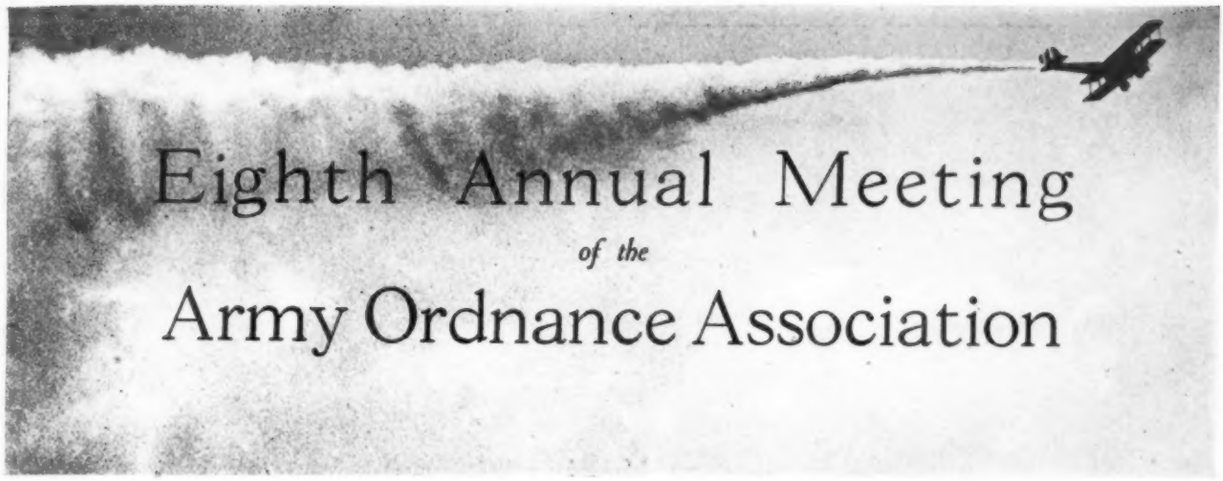
Under present conditions of warfare when consideration is given to the increase in range of weapons and the increase in mobility of troops and artillery through the use of tractors, trucks and other motor transport, it becomes important that a greater range of territory be within the investigated limits of an individual commander.

Some method of quick, rugged, reliable transportation becomes imperative and such a method seems practicable with the present cross-country car. It furnishes speedy transport on roads and remarkably efficient manoeuvering ability across country. It is not possible to hurdle fences or to cross rivers with this car but within reasonable limits it is possible to travel where troops travel.

The motorization of our forces may appeal to some as a bit overstressed. It may seem to be a bit far-fetched to picture the regimental commander flitting about in a flivver. These is less of the picturesque in a review of troops when the prancing horse is absent. The dash and glamour and romance, and all that will have vanished.

But, on the other hand, the single-handed hero of the past has gone down the misty way of absolesence; and the mortally wounded bugle boy, still clutching the flag, no longer inspires the poet to song. In their places we have a grim warrior crouching behind a parapet tossing bouquets of white phosphorous on his belligerent playmates. A gas attack comes and our grim warrior chokes and curses, and struggles for his gas mask; but, too late,—and he dies, gasping, coughing, gurgling—not so picturesque, not so poetic, and not so romantic, but horribly real and terribly complete. He has gone the way of his fighting forbear, not with the bugle ringing in his ear, not with his glazing eyes fixed on his country's flag, and not with the smile of satisfied sacrifice lighting his face. He has died coldly, cruelly, ghastly,—another casualty . . . . . He has been efficiently eliminated in the course of an efficiently organized and conducted struggle.

And so we see in the cross-country car the effect of the cold scientific planning which characterizes modern warfare. Motorized transport is established in the civilian and commercial world. Wise planning for war-time organization quite naturally has included the motor vehicle. The motorization of Army units is a logical move. It follows the best practice of peace-time transportation. And it seems to be fraught with great possibilities. In any event the cross-country car bids fair to become a familiar sight even though it does fall short in romantic appearance.



Eighth Annual Meeting *of the* Army Ordnance Association

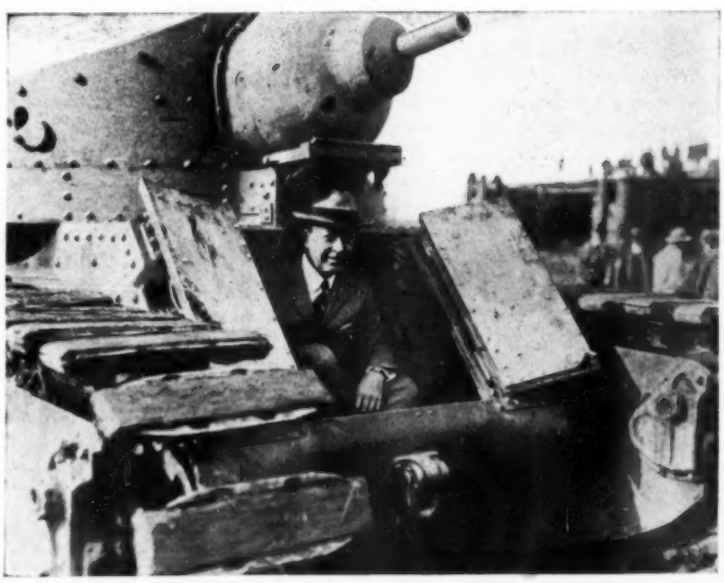
TO say that the Eighth Annual Meeting of the Army Ordnance Association at Aberdeen Proving Ground, October 8, 1926, was the most successful gathering in the history of the Association is but to record the opinion of many of the approximately 3,000 members and guests who were present.

Each year it is customary to record in this place an account of the annual meeting and since each gathering exceeds its predecessor in attendance, variety of demonstrations and, we hope, aroused interest in industrial preparedness, it may not be inappropriate to have the story told this year by one who is not identified with the Association. The following narrative, typical of many which appeared in the daily press, was published in *The Philadelphia Inquirer*.

"War remains always the same, fierce, cruel, merciless, but the machines of war are ever changing. This fact was given overwhelming proof at the Aberdeen Proving Ground today.

"On the 35,000-acre reservation which is the testing ground for all of the ordnance used by the Army, the members and guests at the eighth annual meeting of the Army Ordnance Association had an opportunity to observe just what potentialities the war chiefs of America are assembling for that possible next war.

"They saw an automatic fire control mechanism for the antiaircraft batteries which might even give Colonel Mitchell a few uncomfortable moments; they saw a synchronized sound detector searchlight battery pick up microscopic airplanes from the night sky with their searching beams for the waiting aircraft batteries below.



Hon. Dwight F. Davis, Secretary of War, exploring the interior of an Army tank at the Eighth Annual Meeting of the Army Ordnance Association, Aberdeen Proving Ground, Maryland, October 8, 1926.

"They saw the first public demonstration of a 37-mm. Browning automatic antiaircraft gun, which spat its shells into the heavens with a venomous clatter, a gun incidentally which high ordnance officials predict will revolutionize the shelling of enemy aircraft in time of war.

"These things stood out from among the many demonstrations made during the day from 10 o'clock until after dark.

"The electric fire control for the aircraft guns manufactured at the Frankford Arsenal in Philadelphia in particular attracted the attention of all of the experts who witnessed its action. The results on the range finder are communicated automatically to a dial on the gun itself and one hundred guns may thus be automatically leveled at the plane-filled heavens, as well as one.

"The whole tendency, as one officer expressed it, is to eliminate the necessity of thinking from the gun crew itself. 'The less brains we have the better,' this same officer remarked. 'If one of the crew gets to thinking and tries to correct what he believes to be an inaccuracy in the readings of the finder there is trouble.'

"No less significant than the development in Army Ordnance, shown here today, has been the great number of prominent men in industry who have given up their business to be present at the demonstration. Approximately three thousand people, some of them women, trudged back and forth from the plate range, where the antiaircraft batteries were functioning, to Phillips Field, where the air maneuvers were held and then to the front line when the French seventy-fives, the tanks, tractors, a field

Field Artillery Troops in Action

A battalion of the 6th Field Artillery from Fort Hoyle, Maryland, after maneuvering into position, registers on a target with shrapnel at the Eighth Annual Meeting of the Army Ordnance Association, Aberdeen Proving Ground, Maryland, October 8, 1926.

artillery battery and the various bores of light guns, were putting on their best acts for the instruction of the spectators.

Gun Shoots Thirty Miles

"The mere fact of the crowds, and not simply curious, but intensely interested crowds, showed undeniably to what good effect the plea for industrial mobilization, as provided by the National Defense Act of 1920, has been put in arousing the industries of the country to the part which they can and must take in the next, if there is any next, national emergency.

" 'The bitterest lesson which we learned from the war,' was the way in which Assistant Secretary of War Hanford MacNider phrased it, this afternoon. He spoke at the annual business meeting of the Army Ordnance Association, at which Dwight F. Davis, Secretary of War, Maj. Gen. John L. Hines, Chief of Staff of the Army, and Maj. Gen. Merch P. Stewart, commandant of the United States Military Academy at West Point, also spoke.

"The visitors were conducted first to the huge 16-inch gun, crouching menacingly on its barbette carriage on the gun range. After explaining that the gun weighs 170 ton, is 68 feet long, and hurls a projectile at the rate of 187 miles an hour, and can pierce 16-inch armor plate at the distance of 30 miles, the announcer advised his listeners to put their fingers in their ears.

"The mighty gun leaped like a beast suddenly given life, a great brownish yellow mushroom of smoke belched from the muzzle and there was a tremendous explosion. If there ever is, literally speaking, a crack of doom, it will probably sound something like that. When the spectators took their fingers from their ears, they could hear the mournful wail of the projectile in diminishing degree as the more than a ton of high explosive and steel sought its eternal resting place, thirty miles distant in the shallows of Chesapeake Bay.

Attack Plane Up 4,000 Feet

"The antiaircraft exhibition on the plate range, proved to be one of the most interesting demonstrations of war-

Antiaircraft firings at a target towed by an airplane conducted by a battery of the 61st Coast Artillery (A. A.) Regiment from Fort Monroe, Virginia, at the Eighth Annual Meeting of the Army Ordnance Association.

Chief of Staff Recruits a Notable Gun Crew

Maj. Gen. John L. Hines, Chief of Staff, U. S. A., is shown firing an antiaircraft gun at the Eighth Annual Meeting while Col. Hanford MacNider, Assistant Secretary of War, acts as pointer. Waiting to help reload are, left to right, Hon. F. Trubee Davison, Assistant Secretary of War; Hon. Benedict Crowell, President, Army Ordnance Association and Director of Munitions during the World War; and Maj. Gen. C. C. Williams, Chief of Ordnance, U. S. A.

fare of the day. The new Browning automatic, the 37-mm. gun, was first trained on the slightly clouded heavens, as a Dehaviland Four airplane charged at right angles to the muzzles of the guns, pointed inquisitively heavenward like the muzzles of setter dogs. The plane was flying at an altitude of about 4,000 feet and was trailing behind it, on a 1,000-foot cable, a sleeve target. The target is made of cloth, like a leg o'mutton sleeve of the nineties, is about five feet in diameter, and about fifteen feet long, smaller than the fuselage of the average pursuit plane. High in the heavens, it looked scarcely larger than a grain of wheat.

"The ordnance officers at the finder barked strange readings in speed, altitude, drift and so on, a whistle tooted, the diminutive gun barked sharply, measuredly and into the heavens, like sparks blown from a threshing floor, shot a stream of tracer bullets. They enveloped the sleeve behind and before, above and below, in incandescent profusion. After it had spoken its rebuttal to the challenge of the airman, the mutiple mount .50-caliber machine guns were given their chance.

"Four of these business-like weapons, sounding like nothing so much as noisy typewriters, were mounted on one carriage and three on another. Again the tracer bullets whistled visably into the sky close to the target.

"Finally, the 3-inch guns, operated by a battery of the 61st Antiaircraft Regiment from Fort Monroe, took up the hymn of hate, again the spectators were compelled to use their fingers to shut out the sound. The sharp far crushing blast of the guns as they repeated their salvos was terrific. Long tongues of vermillion flame leaped from the giant barrels as the gun crew wheeled them on their axes, following the hazardous flight of the Dehaviland observation plane.

Ordnance Department, U. S. Army, exhibits the new multiple mount machine gun—the latest antiaircraft weapon, at the Eighth Annual Meeting of the Army Ordnance Association at Aberdeen Proving Ground, Maryland.

Powerful 37-mm. Gun

"Following lunch served at the Proving Grounds Service Club, the gallery was again conducted to the main front, where a bomber, swooping over at about 4,000 feet, released a

660-pound demolition bomb. Although the explosive struck the earth fully two miles from the spectators, the fury of its blast could be told by the geyser of earth which leaped a hundred feet into the air, as it detonated.

"The 37-mm. is a bit of a pet of Chief of Ordnance, Maj. Gen. C. C. Williams, and his associates in the Department, apparently, for it was given a second opportunity to demonstrate its prowess later in the day. Equipped with a supersensitive fuze its projectiles were fired at a distance of several hundred yards against the wing of an airplane placed upright on the ground. The fuze is so sensitive that the shell is detonated on contact. This means that one of these bullets will not, in the future, have to register a direct hit on the aviator or some vital part of his plane to cripple it.

"While in flight one of these shells ejected from an antiaircraft battery on the ground will detonate on contact with the plane fabric, and explode, tearing a great hole, and scattering its fragments about like a small shrapnel. Its use in the event of war is obvious. No more will the jubilant aviator be able to taxi into his flying field after a brush with the enemy 'archies' and point contemptuously to the number of small round holes in the rudder, wings, and fuselage of his plane. If he gets back at all, he will be able to crawl through the holes which the Aberdeen 37-mm. archies will inflict.

"The tanks and tractors had their innings at the same field, where the lumbering insensate brutes of war clattered about on their caterpillars, like antediluvian beasts, coughing shrapnel and bullets from their narrow gunports. The little cross country cars, manufactured to replace the horse for that duty, gave the crowd some of the few laughs of the day. There is a certain incongruity in laughing at a 16-inch rifle, or an aerial bomb, which cannot only laugh last but also longest and loudest.

Flivver in Military Sun

"The fleet little cars, geared with six speeds forward and three in reverse, clattered through mud puddles, clambored over rail hurdles, climbed precipitous declivities, ploughed through swamps, and in general acted so very businesslike, that the laughter rippled through the throng. The flivver has even gained its place in the military sun!

"Various speed recording mechanisms, dynamometers and so on, to the explanation of which the non-technical minded portion of the crowd listened with respect, if not with complete comprehension, were then displayed. A battery of the Sixth Field Artillery from Fort Hoyle, galloped on to the field, dragging the French seventy-fives, which played such a heroic part in the World War.

"Training the fire on a hypothetical target a mile distant, the whistling sound of the projectiles, followed by the dull boom, as they detonated along the edge of a distant woods, filled the air to the exclusion of conversation or anything else.

Night Firing on Aircraft

"Night firing of the antiaircraft batteries was the final spectacle of the day, and a spectacle it was. Out of the dark, enclosing heavens came the hum of powerful motors, far overhead, in the darkness. Indistinct figures bustled noiselessly about the great quadruple-horned sound detector, its phones circling this way and that like the ears of an elephant at bay. The same mechanism which controlled the detectors also controlled the powerful searchlights, which poured their rapier-like beams up against the distant clouds. First the glistening fuselage of the plane was picked up, and the rays of the lights then slid back, back along the sky, until the little pellet of the sleeve target was brought into relief, again the barking of readings from the range finders, again the blast of the gunnery sergeant's whistle, and then the countryside became resonant with the baying of the hounds of war, as the antiaircraft batteries leaped into action.

"In the split second intervals of silence could be heard the eerie wail of the projectiles, while all about the target the exploding, low-powered sharpnel pricked spouts of lurid fire."

PROCEEDINGS OF THE BUSINESS MEETING, ARMY ORDNANCE ASSOCIATION, OCTOBER 8, 1926

The meeting was called to order at 3:30 P. M., Hon. Benedict Crowell, President, presiding.

Mr. Crowell: The meeting will please come to order. Gentlemen, this is the Eighth Annual Meeting of the Army Ordnance Association. Our guests today, as you know, are the members of the National Association of Manufacturers, the National Industrial Conference Board, the Reserve Officers' Association of the United States, and the American Society for Steel Treating.

During the past year the Association has carried on about as usual. We have lived within our income, we have not encroached upon our surplus, and we have enlarged Army Ordnance, our official journal.

The first order of business is the report of the Chairman of the Committee of Tellers on the recent election of Officers and Directors of the Association.

Captain Codd: Mr. President, the Chairman of the Committee is not able to be here and has asked me to read the following report. (The report is published on page 194.)

Mr. Crowell: The report will be filed. Gentlemen, it is with regret that I announce the transfer of our able Secretary, Major R. L. Maxwell, who has been transferred to duty with the 1st Cavalry Division at Fort Bliss. I am glad to say that Major Charles R. Baxter has been assigned to duty in his place. Major Baxter—

Major Baxter: I am sure I cannot perform the duties of Secretary of the Army Ordnance Association as ably as Major Maxwell, my predecessor, but at least I can carry on and do my best. I thank you.

Mr. Crowell: Gentlemen, we are honored today by having with us the Secretary of War, Hon. Dwight F. Davis.

Mr. Davis: It is a real pleasure to have this opportunity of saying just an informal word of welcome to our distinguished guests today. In fact, it is always a pleasure to welcome visitors to Aberdeen because I can say perfectly frankly that I am very proud of the work the Ordnance Department is doing up here. I think they deserve a great deal of credit and we are pleased to see visitors at any time.

I was also particularly pleased today that we were honored by the presence of a man who was one of our best friends in Congress during the last session, the acting Chairman of the Military Affairs Committee of the House, Mr. W. Frank James of Michigan. He was a very good

friend of the Army, is very much interested in the work, and we are always glad to see him. We are particularly glad to welcome members of Congress because we want them to know what we are doing. I think the more they see of Aberdeen and the work we are doing, the more they will give their hearty support to that work.

I want you members of the Army Ordnance Association to realize how deeply we appreciate the interest you continue to show in the work of the Department. It is an inspiration to the officers in their work and they get a great deal from the civilian backing which you give them. Besides the information, advice and assistance you can give them, there is a moral and spiritual backing. Sometimes we feel a fellow needs a friend, particularly when Congress is in session, and we feel we have friends in the Army Ordnance Association, men who are backing up national defense.

We are also glad so many members of the National Association of Manufacturers were able to be here today because we want the business men of this country to realize that after all the national defense, and particularly the industrial side of national defense which we are coming to realize is the most important factor of it, is a business proposition. It is your problem just as much as our problem. We have the legal duty, you have the patriotic and moral duty to assist us. We think you realize that today and to me it has been a real inspiration, I admit a surprise, to find the way the American business men, some of the busiest men of the country, are willing to give of their advice and counsel and assistance whenever we call. It shows that the American business man is patriotic to the core.

I just wanted to say a word of welcome to show how cordially we appreciate the assistance you give us.

Mr. Crowell: The whole matter of industrial preparedness now centers in the office of the Assistant Secretary of War who carries out the policy of the War Department under the direction of the Secretary. It is with great pleasure that I present the Assistant Secretary of War, Col. Hanford MacNider.

Colonel MacNider: I am such a brand-new member of the Army Ordnance Association that it would be fresh and impudent indeed if I tried to talk. It is inspiring to find men of such character and ability in your organization and whom you have here as your guests. I think you realize the important position we are in in industrial preparedness work. The Secretary of War is the man who built the whole foundation for the work which is now going on. He is the head of all the War Department activities and can give it the place which it deserves. After all it is no use training men unless we can shelter them, feed them and clothe them and unless we can arm them. The head of the Army Ordnance Association is perhaps as much responsible as any one man. To see the kind of preparedness we have made we hope will make it unnecessary in the future for us to use it. It is assurance to the nation that we are insured against any war of aggression, an assurance which every American wants.

I want to add our continued thanks for the magnificent help you are giving us.

Mr. Crowell: You all know the business of the entire War Department is directed by the General Staff. You all know the very brilliant military record of the present Chief of Staff, Maj. Gen. John L. Hines. I take great pleasure in introducing him.

General Hines: Gentlemen of the Army Ordnance Association, I have reached the stage in my career when it is natural to suppose I know everything relative to the Army, but I must admit reluctantly that I have seen a great many things today I didn't know existed in the Army. It has filled me with pride to see some of the improvements that have been made by the Ordnance Department and I think the Ordnance Department is deserving of your support. As a line officer I have watched the career of the Ordnance Department of the Government for about forty years and it has been a very interesting thing to watch. I can very distinctly remember a time not so very long ago when it was a common piece of knowledge in the Army that the Ordnance Department always tried to find out what the Line of the Army wanted in order that they might give them something else. This has entirely changed in the last few years and we find the Ordnance Department working to give the Line of the Army what they want and what suits them best. Now for the first time in the career of our Army we find the Line and the Ordnance Department working hand and glove. The Line of the Army is not only asked to put before the Ordnance Department its ideas and tell the Ordnance Department what it wants but it is required to do it. The Ordnance Department is highly deserving of every consideration and support you can give it and I feel the Line is squarely behind the Ordnance Department at this time.

It is a great pleasure to be here today and to see you all. I ask your support of Ordnance, which I am sure it deserves. I am very glad to have had this opportunity of expressing my appreciation of the Ordnance Department of the Army.

Mr. Crowell: The future of the Army of the United States lies in the United States Military Academy which, in my opinion, is the greatest university in the world. The training that the cadets are getting there today is going to determine our army of the future. We are privileged to have with us the Commandant of the U. S. Military Academy, Maj. Gen. Merch P. Stewart.

General Stewart: I trust that you all appreciate the reluctance and indeed the embarrassment with which I raise my voice in this high ranking and highly technical assemblage. I have followed the demonstrations here today with the greatest of interest and I hope with some profit to myself, although I find myself being continually reminded of an old definition of the word "highbrow" which used to be very popular around the War Department. They said a highbrow was a man who was being educated beyond his own understanding. I had something of this feeling today.

I find I have not given much thought to the subject of ordnance for something over thirty years, and as I look back upon the standing I had in my class in ordnance I am inclined to think my instructors thought I didn't think much at that time. However, there is one thought that has appealed to me today as I have watched these demonstrations and it is this: that the great ordnance industry and the industry with which I happen to be identified for the time being, are in every respect twin industries. Together we produce the two elements that go to make up the perfect fighting machine. Here, as you have seen today,

the Ordnance Department has been able to take raw material, shape it, develop it according to minute specifications, and make a perfect agency of destruction. Up there on the Hudson at West Point we take raw material and make the man, the other member of this great fighting team, the man and the gun. Of course it is pleasing to us to think that no matter how powerful, how perfect these agencies of destruction which we have seen today may be, they are no good without the product of our institution. Of course you might very readily say that the product of our institution is of no particular good without the product of the Ordnance institution, but that is not my side of the argument. For those of you who may not be familiar with the Military Academy, there is a remarkable parallel between the production of the perfect weapon and the production of the human element that enters into it. Here the Ordnance Department takes the raw material, puts it into shape, develops it, and perfects it; we take crude raw material coming from a great variety of sources. We throw it into the melting pot of the Military Academy, we train it, develop it, shape it, finish it off, and in the end turn out a product as standard and as uniform as that which you have seen here today.

I am not going to take any more of your time except to say it has been a great privilege for me who have given very little thought to the subject of ordnance, except the shooting side, to have been here today and to have seen what we have all seen. It has been a great privilege to see the assemblage of representative men who have come here today, and who by their presence are lending aid and support to the Army and national defense. I trust some day I may invite some or all of you to come to West Point and see how we handle the other end of the problem. I tell you we can't make anything like the noise you have heard today, but we will try and give you something that will be entertaining if not instructive.

Mr. Crowell: I want to thank you who have come here today as our guests for your interest and cooperation, and I believe Industrial Preparedness, the cause in which we are interested, will be much benefited by your visit.

At a meeting of the Board of Directors, Army Ordnance Association, held immediately following the business meeting, among other matters taken up was the passage of the following resolution thanking Maj. R. L. Maxwell, Ord. Dept., U. S. A., for his services as Secretary of the Army Ordnance Association from July 1, 1925, to October 7, 1926:

"Whereas the needs of the military service made necessary the recent transfer of Major R. L. Maxwell, Ord. Dept., U. S. A., to duty with the 1st Cavalry Division at Fort Bliss, Texas, and

"Whereas said transfer required that Major Maxwell relinquish the office of Secretary of the Army Ordnance Association which he filled from July 1, 1925, to October 7, 1926, and

"Whereas the Association, during the tenure of office by Major Maxwell, carried on its activities for Industrial Preparedness in a most effective and beneficial manner,

"Therefore be it resolved that it is the sense of this Board that to Major Maxwell is due the thanks of the officers and members of the organization for his untiring and loyal efforts. And be it further resolved that a copy of these resolutions be spread upon the Minutes of the Association, that they also be published in Army Ordnance, the journal of the Association, and that a copy of them be forwarded to the Chief of Ordnance for file with Major Maxwell's service record.

Benedict Crowell,
President, Army Ordnance Association.

Chas. R. Baxter,
Secretary.

International Standardizing Body Proposed

According to the current issue of the American Society for Testing Materials' Bulletin, the meeting in this country last spring of the third International Conference of National Standardizing Bodies, of which the American Engineering Standards Committee is the American member, led to the proposal that there be organized an international standardizing association of which the members would be the respective national standardizing bodies and having for its purposes the facilitating of general contacts between these bodies to the end that uniformity among national standards may be promoted, with ultimately the function of approval of international standards. A constitution to govern the activities of the proposed association was formulated and presented to the national standardizing bodies for their consideration. The Executive Committee has presented the views of the Society in a communication addressed to the Chairman of the A. E. S. C. These views may be briefly summarized as follows:

1. The Society favors international engineering standardization where the needs and advantages have been clearly defined and the procedure to be followed is acceptable.

2. The Society urges the importance of careful and deliberate consideration of the whole proposal on the part of American industry, the A. E. S. C. and its member bodies, and is opposed to hasty and possibly ill-considered action.

3. The formulation of international engineering standards should be based upon the principles that govern the activities of the A. E. S. C. (A procedure was suggested for American participation in international engineering standardization.)

4. The proposed constitution is quite indefinite with respect to the attainment of the fundamentally important purpose of approval of international standards, and American participation in this movement should be subject to agreement on procedure between the A. E. S. C. and its member bodies.

Projectiles—Selfrotating and Selfpropelling

Maj. C. H. Goddard, Ord. Res. U. S. A.

EVER since the superiority of rifled weapons over those smooth of bore became generally recognized, inventors have striven toward developing methods for imparting angular velocity to projectiles by means other than the use of spiral grooving in the barrels from which they are driven. It requires no very active imagination to understand that a smooth-bored gun is fashioned faster and more cheaply than a rifled one, and if such a piece can hurl missiles which rotate as rapidly and as steadily as those issuing from one which is grooved, great saving in time and cost of manufacture may be effected. Furthermore, in the rifled arm much of the energy of the propellant charge is utilized in overcoming the friction offered by the lands, the absence of which in the smooth bore permits the employment of the energy formerly so devoted, toward the acceleration of the projectile, whose flight, other things being equal, should thereby become materially prolonged.

As a result, the number of patents taken out thus far in the United States for ideas upon selfrotating projectiles is by no means inconsiderable. I use the term "selfrotating" rather broadly, to indicate the employment of any means, save rifling the gun bore, to effect rotation.

Intimately bound with the idea of selfrotation, in the minds of many inventors at least, is that of selfpropulsion. By this I would designate any method of launching a missile through power released *from within itself*, rather than by a charge of explosive, compressed gas, or liquid, external to it. This presents another idea fraught with most interesting possibilities. Consider for a moment the tremendous advantages attaching to an infantry projectile carrying its own powder charge in a hollow base, the reduction in weight per round resulting from the elimination of the cartridge case, the infinitely less space occupied by a given number of rounds than under present conditions, and the correspondingly greater quantity which the individual soldier could transport. Truly, selfrotating and selfpropelling projectiles are pretty things to think about, and to toy with, so it is no small wonder that even the Wizard of Menlo Park has given the matter sufficient time and thought to have developed and patented at least one idea for accomplishing the former.[1]

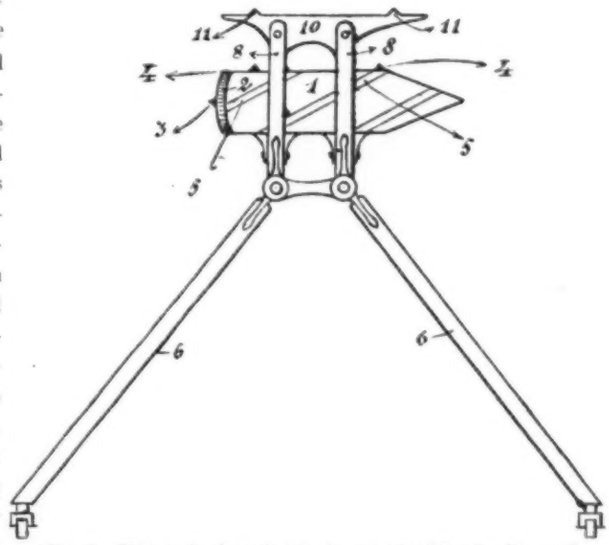


Fig. 1. The explosive charge is attached to the base of the projectile which rests on a small arc-shaped support eliminating the use of a gun barrel.

Since the attributes of selfrotation and selfpropulsion appear so frequently in conjunction it becomes hardly feasible to treat of one without the other. Hence this paper endeavors, in a general way, to cover the fields occupied by both. In its preparation, the United States Patent Office records from 1783 to 1925, inclusive, as available in the files of the New York Public Library, have been diligently searched. If, in spite of this, omissions exist they will be due in the main to the fact that the items overlooked were not included under the heading "Projectile," in the index, or if so listed, were followed by modifying adjectives which indicated that they did *not* fall among the groups sought. Every item listed simply as "Projectile,"—many hundred in all,—has been examined, and its drawings and specifications studied. This was early found necessary, for search of the listings, "Projectile, selfrotating," and "Projectile, selfpropelling," brought to light scarce a baker's dozen altogether. A survey of the whole "Projectile" field, however, disclosed some forty-eight of the former and fourteen of the latter, while in nine other instances both properties were embodied in the same missile. No attempt was made, however, to search under the headings, "Ammunition," or "Cartridges," nor were the patent records of other countries consulted. In addition, the report of the Commissioner of Patents for the year 1858 was not available. With these exceptions, however, the lists that follow may be considered complete.

TOTAL NUMBER OF PATENTS ISSUED

Year	Selfrotating	Selfpropelling	Selfprotating and Selfpropelling
1856	6	1	..
1857	1	..	..
1860	1	..	..
1861	2	..	..
1862	5	..	..
1863	2	..	..
1869	..	2	..
1871	1	..	..
1876	1	..	..
1877	1	..	..
1885	..	3	..
1886	1	..	..
1889	3	..	..
1890	1	..	..
1891	1	..	..
1892	1	..	..
1893	..	..	1
1894	1	..	..
1895	2	..	..
1897	1	..	1
1901	1	1	..
1903	2	..	1
1904	1	..	..
1906	1	..	..
1910	2	..	1
1912	..	..	1

1U. S. Patent No. 1,297,294, March 11, 1919. (This falls under Group B-I, Subgroup A, next page).

Year	Selfrotating	Selfpropelling	Selfrotating and Selfpropelling
1915	..	1	..
1916	4	..	..
1917	..	2	1
1919	2	1	1
1920	3	1	..
1921	1	..	2
1923	..	1	..
1924	..	1	..
Total	48	14	9

Just why, from 1783 down to 1856, no genius bent his energies toward patenting projectiles of these types, is a question that will probably remain unanswered. It is certain that the idea of selfrotation, at least, had received no little attention from inventors prior to the latter date, for Dahlgren in his book *Shells and Shell Guns* (King & Baird, Pubs., Philadelphia, 1856) says (p. 128): "Attempts have been made to dispense with rifling the bore, and to procure the rotatory movement by channelling the surfaces of elongated projectiles. Also, to dispense even with this, and consequently with the rifle motion, entirely,—substituting therefor certain peculiar forms which were supposed to have the power of preserving the apex of the shot or shell foremost. Numerous devices of this description have been submitted by inventors, and have been ordered to be tried by me, without success in any one instance . . . . . I may say, however, ... that the failure of these projectiles . . . . . is not to be considered as finally determining the interesting question of imparting rifle movement to the shot or shells of heavy ordnance. Other efforts have been made which, though not so well known, promise to afford better results."

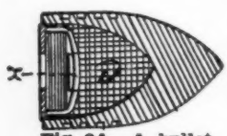


Fig 2A. A bullet with base hollowed out to contain the propellant charge.

Nine years later, Holley, in his treatise *Ordnance and Armor* (Van Nostrand, Pub., New York, 1865) says (p. 571): "Various schemes have been devised for rotating smooth projectiles. When this is done with wings, or their equivalents, acting against the air after the shot leaves the gun, the velocity of rotation has been found insufficient; more than this, the accuracy of such projectiles has appeared to be more impaired by the resistance of the air than that of ordinary projectiles which received their spinning motion before leaving the gun. But it is possible that projectiles may be made to spin with sufficient velocity to insure accuracy by the action of the powder gas, *before* they leave the gun; if such projectiles are centered, they should move with as much accuracy as others of similar shape *after* leaving it."

It is quite clear from the above references that the idea of selfrotation was not born suddenly in 1856, since it was then already well known to ordnance engineers. Just why it blossomed forth so copiously at this time in our patent records where it had never before appeared, is difficult to determine. It is true, however, that the value of rifled ordnance was then beginning to receive considerable recognition, and but natural that inventive minds should turn at the same time toward developing, if possible, simple but effective substitutes. The Civil War period which shortly followed was naturally fertile in the production of these, as of many other, patents in the field of arms and munitions, whereas the output languished in the pacific decades that followed. It recrudesced once the World War was well begun, and did not wane until 1923.

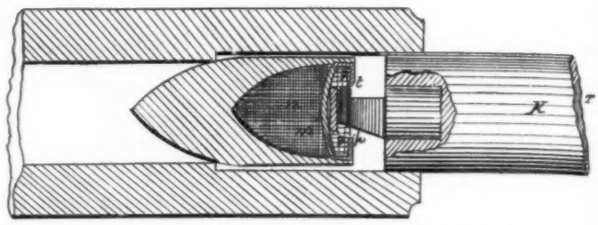


Fig. 2B. The action of the firing pin on the bullet shown in Fig. 2A.

And if inferences may be drawn from past experience it is reasonable to suppose that new features along these lines will be patented so long as human beings continue to hurl missiles at one another.

As may readily be surmised, the majority of the ideas embodied in the seventy-one inventions which were the total sifted out from the hundreds examined, can be classified in a few general groups. An exposition of these in a somewhat abbreviated form, taking first the selfrotating types, next the selfpropelling, and lastly combinations of the two, may not be without interest. Thus we have:

Projectiles, Selfrotating

Group A. Rotation effected by gas pressure on base, through following devices:

1. Powder gases act against sectors or inclined planes on base *of projectile* proper.
   1a. Powder gases act against turbine wheel in base.
2. Powder gases act against sectors or inclined planes on base *of sabot.*
3. Powder gases, entering perforations in base, traverse passages cut spirally in body and emerge through ports on the nose.
4. Powder gases act upon sides of spiral grooves cut superficially in cone-shaped *base* of projectile, cylindrical bearing surface being forward, instead of to the rear.
5. Powder gases act upon sides of spiral grooves cut supercifically on rear surface of projectile's head, cylindrical bearing portion being less than bore diameter to allow forward passage of gas.
6. See combinations of selfrotating principles, below.

Group B-I. Rotation effected by pressure of *air externally.*

Subgroup a; Air acts on *nose.*

1. Air acts against inclined planes or sectors cut in nose.
2. Air acts against spiral grooves cut supercifically on nose.
3. Air acts against spiral vanes set in nose.
4. Air acts against spirally fluted *flat* nose (to produce drilling effect; a special purpose projectile, fired from rifled piece.)

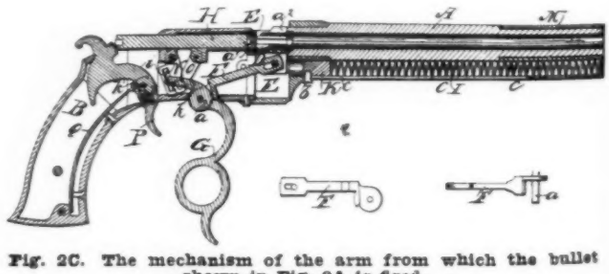


Fig. 2C. The mechanism of the arm from which the bullet shown in Fig. 2A is fired.

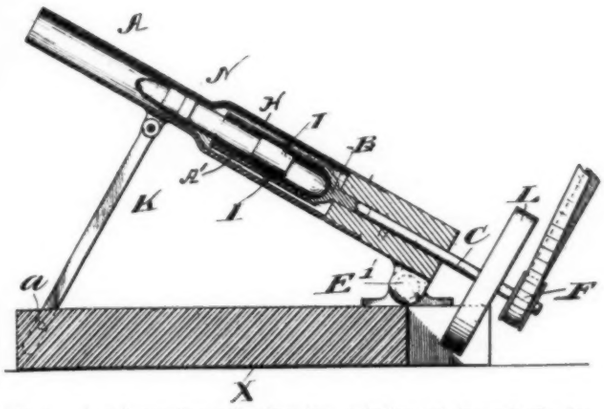


Fig. 3. A scheme for effecting the rotation of the missile by revolving the weapon.

5. Air acts against spiral grooves in nose, which is revolubly mounted on an axial shaft, causing same to rotate for special purposes. Fired from rifled piece.
6. Air acts against spiral grooves in nose, causing thin outer casing to revolve on ball bearings about inner core.

Subgroup b; Air acts on *body.*

1. Air acts against inclined vanes that unfold outward from body after projectile leaves muzzle.

Subgroup c; Air acts on *base or tail.*

1. Air acts against inclined vanes unfolding outward from base after projectile has left muzzle.
2. Air acts against propeller at end of an axial shaft which extends rearward from base of projectile.

Subgroup d; (Combination of subgroups a, b, and c.)

1. Air acts against spiral grooves starting on nose and extending to base.

Group B-II. Rotation effected by pressure of *air internally.*

1. Air acts against spiral plates or vanes mounted in an axial cavity which traverses projectile from end to end.
2. Air enters an axial cavity closed at rear but communicating through spiral passages with ports on surface of projectile.

Group C. Rotation effected by rollers distributed parallel and equidistantly about periphry of cylindrical portion of projectile, with axes of rotation tangential to its surface, and lying in planes which intersect axis of projectile at a slight angle to the perpendicular.

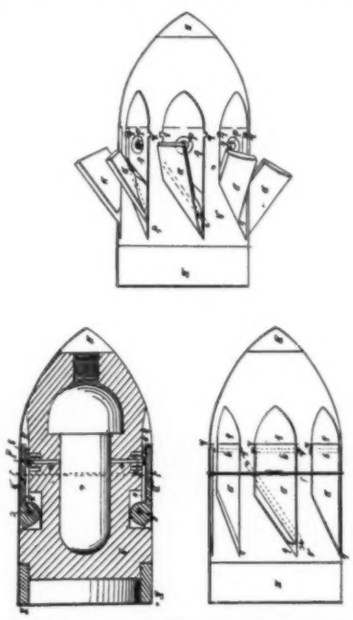


Fig. 4. A projectile with outwardly folding vanes to effect rotation.

Group D. Rotation effected by actual revolution of the projecting piece itself.

Group E. Rotation effected by pressure against gun bore of gases escaping from a series of ports located equidistantly upon and tangential to the surface of conically shaped tail of projectile. See Fig. 7.

Subgroup a.

Rotation effected by escape to the rear through spiral passages, of gases generated in a cavity in body of projectile. (See also combinations of selfrotating and selfpropelling principles, below.)

Group F. Rotation effected by impulse imparted to head of projectile at instant of its separation from a rear portion of greater diameter, on emerging from muzzle of piece (See also combinations of selfrotating principles, below.)

Group G. Rotation effected by escape of gas generated within projectile itself, through spiral ports at rear end of hollow tail shaft. (See also combinations of selfrotating and selfpropelling principles, below.)

Group H. Separate projectiles of decreasing size, nested within each other and geared one to another by grooves and flanges, are projected forward from time to time by the explosion of auxiliary charges, acquiring angular velocity as they separate owing to peculiar construction. (See also combinations of selfrotating and selfpropelling principles, below.)

Fig. 5. An instance in which a tail propeller is used to effect rotation.

Not a few projectiles designed for self-rotation embodied more than one of the principles above outlined. Of these there were nine examples noted. The groupings under which they fall appear below, together with descriptions of certain types not previously discussed.

Combinations of Selfrotating Principles

GROUPS AND SUBGROUPS FOUND IN COMBINATION.

No.	Group	Subgroup and	Group	Subgroup
1	A-1	....	B-1	a-2
2	A-3	....	B-1	a-1
3	A-2	....	B-1	a-2
4	A-1	....	A-4	....
5	A-6	....	B-1	d
6	A-3	....	B-II-1	....
7	B-1	c-1 and a-3	F	....
8	B-1	a-3	B-1	c-2
9	B-1	a-2	B-1	c-2

It will be noted that, under item five of the above list, Group A-6, not previously discussed, makes its appearance. It is represented by a single example only, but a very interesting one. In this case the projectile is geared to its cartridge case by longitudinally disposed grooves in its surface, set parallel to one another and at a slight angle to the long axis of the cartridge. (Fig. 10). These register with corresponding projections or ridges on the interior of the shell case. Rotation naturally takes place as the missile departs from the case.

In item six we come upon a reversible projectile which is piereed end to end with a spirally flanged axial cavity. When rotation through air presure is desired, a base cap is applied which falls away as the missile emerges from the muzzle: when through gas pressure, the projectile is

reversed and a nose cap, remaining in place throughout its flight, employed.

Item seven offers another unusual practice in that it relates to an elongated, cylindro-ogival projectile of considerably less than bore diameter, coupled to which is a short, detachable, disc-shaped base which completely fills the bore. Studs on the surface of an axial shaft set in the anterior face of the base and projecting forward into a corresponding cavity in the rear end of the projectile head proper, engage in spiral grooves cut in the walls of said cavity. When the projectile leaves the muzzle, the air pressure against the base is relatively much greater than that against the head because of its greater cross section and lesser weight, and the two portions part company forthwith, the head acquiring angular velocity as the studs on the base travel rearward through its spiral grooves.

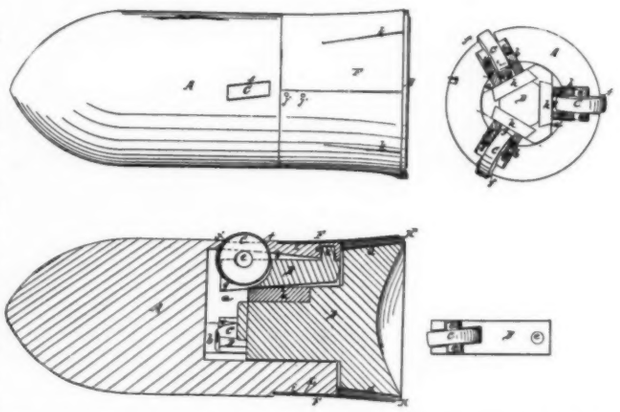


Fig. 6. Here rotation of the projectile is attempted by a system of inclined rollers

This exhausts the list of selfrotating projectiles. Those which are selfpropelled may be classified as follows:

Projectiles, Selfpropelling

Group I. Linear velocity acquired through rearward expansion of gases developed as products of explosion taking place within a cavity located in base of missile.

Subgroup a.

1. Principle same as in Group I, but expansion of compressed air, instead of products of explosion, furnishes the energy required.

Group II. Secondary projectiles axially disposed and nested within each other and within an outer casing which is ejected from the gun in the usual manner, are released and driven forward successively by the explosion of auxiliary charges. (See also combinations of selfrotating and selfpropelling principles.) Two systems are used, thus:

Subgroup a.

Auxiliary charges explode on impact, and:

Subgroup b.

Auxiliary charges exploded by time fuzes.

Group II-A. Secondary projectiles, each with its own propelling charge, are arranged circumferentially, parrallel to each other and to long axis of parent missile, being discharged successively by a timed firing mechanism. (See also combinations of selfrotating and selfpropelling principles.)

Subgroup a.

Like main group (II-A), but secondary projectiles all being released simultaneously through explosion of a single auxiliary charge.

Group III. Linear velocity is acquired through the explosion of a series of booster charges in a projectile built up of a number of short cylindrical sections (each containing a charge), and an ogival head, explosions taking place successively from rearmost section forward.

Combinations of Selfpropelling Principles

In but one instance were two ideas for selfpropulsion combined in a single patent, features common to groups I and III being employed. The projectile involved, embodies no very remarkable characteristics, and no detailed description of it will be attempted.

We now come to projectiles embodying qualities both of selfrotation and selfpropulsion. Of these there are eight types, which may be listed as follows:

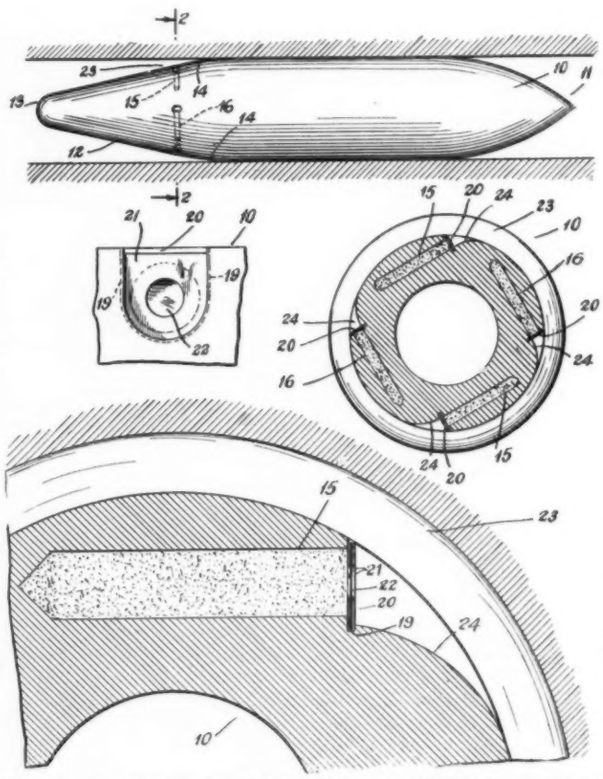


Fig. 7. A projectile in which rotation is effected by pressure against the bore of the gun of gases escaping from a series of ports upon the surface of the conically shaped tail.

Projectiles, Selfrotating and Selfpropelling

Groups and Subgroups Found in Combination

No.	Selfrotating Group	Selfrotating Subgroup	Selfpropelling Group	Selfpropelling Subgroup
1	B-I	a-3	II-A	a
2	B-I B-I	a-2 a-3	I	...
3	B-I G	... ...	I	...
4	E	...	I	...
5	E	a	I	...
6	H	...	II	...
7	H	...	II-A	...
8	H	...	II	b

Two different specimens fall under class four in the above list, all other classes being represented by a single example only, giving a total of nine such patents altogether, as previously noted. Among these, one deserves especial mention (class 2, above.) I have stretched my boundaries somewhat by placing it among projectiles endowed with the property of selfpropulsion, because in the

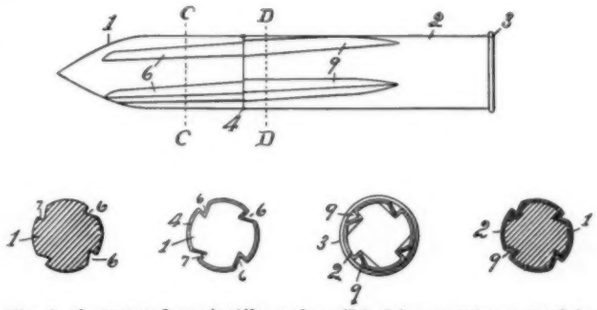


Fig. 8. A grooved projectile and a ribbed brass case geared to it which, with the gases of explosion, imparts a rotary movement to the bullet.

definition of such missiles as set forth in the beginning of this paper, I included only those types which were projected by the release of power *from within themselves*, rather than from some external source. In the instance under discussion, the power is supplied distinctly from an external source, i.e., a charge of explosive attached to the base of the projectile, and not contained within it. Yet, since this particular missile is not restrained or directed by the usual gun barrel, but freely released toward its objective with no other directing mechanism than a small, arc-shaped metallic support on which it rests, I have held it permissible in this case to consider the propellant charge a *part* of the projectile itself, and trust that the critically inclined will bear with me on this point. The whole scheme, which recalls somewhat the method of discharging submarine torpedoes through the use of a dropping gear, is so fearful and wonderful that I have reproduced the patent drawings in Fig. 1.

It is interesting to note that the great majority of the patents uncovered by this study deal with projectiles intended for use in heavy ordnance, and although a number of the designs discussed are adaptable to small arms as well, but two are described by their authors as exclusively so intended. Of these, one, patented in 1861, presented no noteworthy characteristics, and never attained popularity according to any records available. But the other, patented January 22, 1856, by Horace Smith and Daniel B. Wesson, two names long prominent in the history of firearms in the United States, deserves more than casual notice. It embodies the design then first perfected in this country, of a bullet with its base hollowed out to contain the propellant charge. The rear of the base cavity is capped over with a composite disc of brass, steel, and cork, which has a pellet of priming compound at its forward end. On its rear face, the cork is left exposed in the center (being covered elsewhere by a layer of brass), and is pierced by the firing pin in its excursion toward the priming compound. Fig. 2,a, gives a longitudinal section of this remarkable projectile, and Fig. 2,b, discloses the action of the firing pin, while Fig. 2,c, explains the mechanism of the arm in which it was employed. Commercial production of this ammunition and its parent arm (known as the "Volcanic Repeating Pistol" and also invented by Smith and Wesson) was undertaken on a fairly pretentious scale for those days and times. The arms were made in a number of sizes and calibers, the largest being a .44. A "cartridge" for one of these which I recently dissected showed the following weights and measurements:

Length 0.700 inch
Diameter 0.420 inch
Weight, complete, 125 grains
Weight, bullet, empty, 105 grains
Weight, powder charge, 12 grains
Weight, base cap, 8 grains

Fig. 10A. The "Brenneke" selfrotating projectile.

Through the kindness of Mr. J. C. Harvey of Worcester, Mass., who owns one of the finest collections of pistols in the United States, I was lately able to examine a specimen of the .44 caliber pistol. The frame and working parts are of brass, and the hammer transmits its impulse through a solid breech bolt rather than through a firing pin traversing the bolt. Just how the extremely tight breech closure which, in the absence of a metallic cartridge case was absolutely essential to prevent gas leakage, was effected, or the base caps ejected after extraction, is not readily determined from a study of the mechanism. Probably these functions were none too perfectly carried out, as indicated by an experience at the battle of Cold Harbor of an old gentleman still living. He recounts how he fired his piece for the first time on that occasion, whereupon all of the other charges in the tubular magazine exploded, to his great consternation and the complete wrecking of the arm. Not a few of these weapons were carried by Union officers in the Civil War, and many appear in collections today. The ammunition, however, is scarce and rarely seen.

Fig. 10B. The "Stendeback" selfrotating projectile.

This arm, the mechanism of which was developed in rifles as well as pistols, bears added interest in that it was the father of the Henry rifle, which in turn evolved into the first Winchester (model of 1866)—the beginning of a long and famous line.

So far as I can ascertain, the "Volcanic" projectile is the only one of its kind which was ever manufactured in this country in any considerable quantity (and none of these have been made since 1860.) A reasonably close scrutiny of the patent specifications of most of the other types dealt with in this paper will disclose in most instances some defect which renders the idea impractical. The scheme for effecting the rotation of a missile by revolving the projecting weapon at the moment of firing offers an extreme example. (Fig. 3.) Other very fanciful designs are embodied in such patents as the one shown in Fig. 4, where outwardly folding vanes are used to effect rotation. Rotation by means of a tail propeller (Fig. 5) is another curiosity worthy of attention, as is the system of inclined rollers employed for a similar purpose (Fig. 6.) Another most unusual conception appears in Fig. 7 (pre-

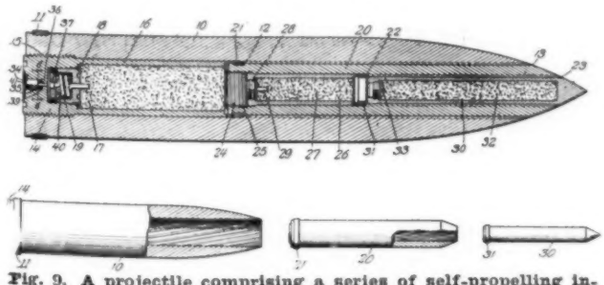


Fig. 9. A projectile comprising a series of self-propelling inclosed missiles, each of which has its own charge to be exploded at intervals.

viously described.) Fig. 8 showing projectile and its brass case, geared to one another (see item five under "Combinations of Selfrotating Projectiles") presents another very novel method of securing rotation, while in the field of selfpropulsion, no more interesting specimen can be reproduced than that which appears in Fig. 9.[1]

On the other hand, where there is so much smoke there is very likely to be some fire. A careful perusal of the specifications covering the projectiles described, combined with a study of the drawings, cannot fail to impress one with the fact that among all the chaff present there are a few ideas worthy of further examination.

Indeed our Teutonic friends, ever awake to possibilities, have developed and marketed within recent years two forms of selfrotating projectiles for use in shotguns which give results far superior to those achieved with the round ball commonly in use on this side of the water. This latter missile, to quote Horace Kephart in his volume *Sporting Firearms*, ". . . will carry straight enough for deer shooting up to forty yards. At one hundred yards they will generally miss a stable door . . .". The German slugs, on the other hand, according to tests conducted by Capt. E. C. Crossman, late U. S. A., make a much better showing. They have been developed in two types. One of these, the "Brenneke", is in the form of a short cylinder, 0.55-inch in length, screwed to the base of which is a second cylinder, of equal length, and composed of a large wad of felt between two of cardboard. Along the sides of the lead cylinder equidistantly spaced and at a slight angle to its axis, run six spirally inclined ribs. The pitch of these ribs and the threading of the axially disposed screw which attaches the base cylinder to the leaden one is such that the revolution of the forward cylinder by the action of the air against its ribs will effect a separation of the two soon after leaving the muzzle, the function of the wads being merely to seal the bore against the escape of gases. This projectile (Fig. 10A), which weighs, complete, 480 grains (lead, 430: wads, 50) will hold uniformly into a 12-inch circle at 50 yards when fired from a 12 gage weapon.

The second form of German-developed selfrotating projectile for shotgun use is the "Stendeback" (weighing 485 grains in 12 gage size.) It is also cylindrical in shape being 0.80-inch in length and pierced end to end by a frustro-conical axial cavity in which are set four spiral vanes in the shape of a cross. This type will hold into a 10-inch circle at 100 yards, developing a muzzle velocity of 1275 f.s. and an energy of 1700 ft. lbs. (Fig. 10B).

Dahlgren's prediction of better results in the future from projectiles of this type was well made. The selfrotating missile has, on actual test, proved its value in certain special fields. But what of the one which is selfpropelling?

Again our late enemies have not been idle. A German inventor recently showed me his model for a selfpropelling rifle bullet which he proposed to adapt to military usage. It was designed in two forms, one of which embodied means for selfrotation as well. The propellant was contained in the usual base cavity.

The possibilities of a self-propelling rifle cartridge which would be of military value appear at present negligible. Because of the limited powder space necessarily available, no velocities worthy of consideration could be attained,—*with propellants now known to us.* But who can say but that the morrow may produce a propellant which will overnight transfer the question of a self-propelling rifle bullet from the realms of foolish fancy to those of stern reality?

With the pistol, the problem appears much simpler. If, in 1856, when priming compositions were uncertain, waterproofing difficult to accomplish, powders none too regular in action, and smooth-working mechanisms hard to produce on the crude machinery then available, it was possible to turn out an arm and a selfpropelling cartridge to fit it that worked *at all*,* how much more possible should it be, in these days and times, to develop along somewhat similar lines a weapon and cartridge that would give satisfactory results? The value of a satisfactory military automatic pistol of this type is readily evident. Who knows that this may not be the next step in the evolution of the small arm?

[1]This projectile incidentally also embodies selfrotating features.

*It may be of interest to record that tests recently conducted by Mr. Merton Robinson, Ballistic Engineer, Winchester Repeating Arms Co., on some of the original Volcanic ammunition showed a muzzle velocity in the neighborhood of 500 f.s.

Ordnance District Chiefs Hold Annual Conference

THE annual conference of the Chiefs of the fourteen Ordnance procurement districts for discussion of the industrial preparedness plans was held in the Office of the Chief of Ordnance October 6, 1926. The conference was preceded by a two-day session of the Executive Assistants assigned to the several districts.

The Chiefs of the Ordnance Districts are: Baltimore, Howard Bruce; Birmingham, John S. Sewell; Boston, Charles H. Tenney; Bridgeport, B. A. Franklin; Buffalo, Ledyard Cogswell; Cincinnati, Charles L. Harrison; Chicago, E. A. Russell; Cleveland, Frank A. Scott; Detroit, H. A. O'Dell; New York, James L. Walsh; Philadelphia, John C. Jones; Pittsburgh, R. M. Dravo; St. Louis, M. E. Singleton; and San Francisco, Bruce Cornwall.

Following the conference many of the district Chiefs attended the industrial preparedness session of the annual convention of the National Association of Manufacturers in New York City, October 7th. They attended the Eighth Annual Meeting of the Army Ordnance Association at Aberdeen Proving Ground, Md., on October 8th.

Instruments for Making Ballistic Determinations and Some Results Obtained at Aberdeen Proving Ground

Maj. Arthur W. Ford, Ord. Dept., U. S. A.

Part II—Pressure Determinations

THE measurement of sustained pressures is readily and accurately made with various commercial gages such as the ordinary steam gage and the automobile tire gage; but when the pressure it is desired to measure, as in gun firing, is in the neighborhood of 4000 atmospheres and maintains its maximum value for about one-one-thousandth part of a second only the determinations are much more difficult to obtain and their accuracy is difficult to establish. At the Aberdeen Proving Ground it is undertaken to determine the maximum pressure in a gun not only, but also to determine the pressure at every instant the projectile is in the gun, the results obtained being used in the design and manufacture of guns, projectiles, and powders.

The Crusher Gage

For many years a type of gage,[4] invented by Major Rodman about 1858 and perfected by Nobel in England in 1863, has been in universal use for measuring the maximum pressures in guns. This gage (Fig. 23) consists of a steel housing, a copper pressure cylinder, a piston, a copper obturating cup, and a device to hold lightly the pressure cylinder in proper position. The powder gas, which is excluded from the interior of the gage by the copper obturating cup, presses on the piston of known area, and compresses the copper cylinder. The different lots of copper cylinders which are manufactured are calibrated in testing machines and tarage tables are compiled from which, the amount of shortening of the copper cylinder being known, may be determined the pressure which produced the compression. This method is used for all calibers of guns and cannons. It is readily seen that the motion of the piston and the flow of the copper cause the introduction of errors due to the inertia effects; and also that the maximum pressure only is obtained. For measuring low pressures experiments have been conducted wherein the copper cylinders have been replaced by lead cylinders. The accuracy of this gage will be discussed later.

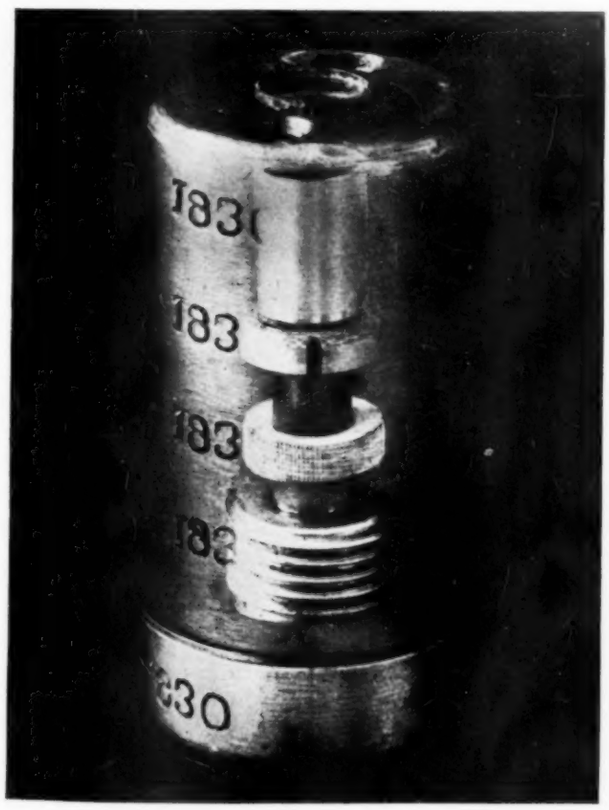


Fig. 23. Medium Caliber Crusher Gage.

Time Pressure Gages

It is highly desirable to know in what manner the pressures which occur in a fire arm are developed so that a space, time, and pressure relation may be established. Some of the earlier experimenters in this field were Bichel, Petavel, and Vieille, whose apparatus are described in Tschappat's *Ordnance and Gunnery*, 1917. Various objectionable features of these devices were smallness of record obtained, inertia of moving parts, laboratory instrument only and not practical of application to guns, etc. At Aberdeen Proving Ground have been tested the Curtis-Duncan pressure gage, developed by Drs. H. L. Curtis and R. C. Duncan, of the U. S. Bureau of Standards, and the Piezo-electric pressure gage, a joint development of the Bureau of Standards and the Aberdeen Proving Ground. Those connected with the latter at the Bureau of Standards are Dr. E. A. Eckhardt and Dr. J. C. Karcher, while Mr. R. H. Kent has conducted the investigations at Aberdeen Proving Ground. Tests with the Curtis-Duncan gage have been discontinued and the more recent tests have employed only the Piezo-electric gage.

The Piezo-Electric Pressure Gage

The need for an accurate and a continuous time pressure relation led to the design, test, and perfection of the Piezo-electric pressure gage as used at the Aberdeen Proving Ground. The Piezo-electrical effect was discovered

[4]Pressure Gage Outfits, Ordnance Pamphlet, No. 1738.

by F. and P. Curie in 1880, and Sir J. J. Thomson suggested in 1919 the use of that effect for obtaining gun pressures, the crystals he proposed using being tourmaline. Dr. G. F. Hull and Captain H. O. Wood later made independent proposals that quartz crystals be used for this purpose. The gage[5] (Figs. 24, 25 and 26) consists of a series of quartz discs, cut with the plane faces of each perpendicular to its electrical axis, with smooth parallel faces, a housing of translucent bakelite, silver electrodes, piston, housing and other minor parts.

The quartz disc when subjected to a compressional force in the direction of its electrical axis, normal to its faces, will liberate a quantity of electricity the magnitude of which, as has been determined, will be proportional to the force applied. By increasing the number of discs and connecting them in parallel the total quantity of electricity liberated is increased due to the increased plate area. If terminals are led from each side of the discs and connected to a galvanometer a current will flow, and a deflection of the galvanometer will be produced. This being recorded on a moving film gives a curve from which the pressure exerted is determined. The pressure being applied to the hemispherical portion insures that it be normal to the faces of the discs and decreases any tendency to crush them by distortion. Beeswax is used to seal the gage and prevents gases entering the gage and occasioning erroneous results. The gage is calibrated by means of a Crosby fluid pressure scale, the calibration curve being a straight line.

Tests have been made at Aberdeen Proving Ground, with a 240-mm. Howitzer mounted on a free recoil carriage and firing projectiles thoroughly lubricated and having the rotating bands machined off so as to offer slight resistance, to test the accuracy of this gage. It has been determined that it does record the pressure curve accurately and that by it accurate numerical results are obtained provided the calibration has been accurate. A means of utilizing the camera of the Solenoid Chronograph for recording the time pressure relation when using this gage has been perfected by Mr. R. H. Kent of the Aberdeen staff, and has proved entirely satisfactory.

5For a complete treatment of the subject, see Scientific papers of the Bureau of Standards, No. 445, "A Piezo-electric method for the Instantaneous Measurement of High Pressures," by J. C. Karcher.

See also "Experiments in Interior Ballistics," by Col. W. H. Tschappat, Ord. Dept., *Mech. Eng.*, Aug., 1926.

Keys, D. A., "A Piezo-electric method of measuring explosion pressures," *Phil Mag.*, Oct., 1921.

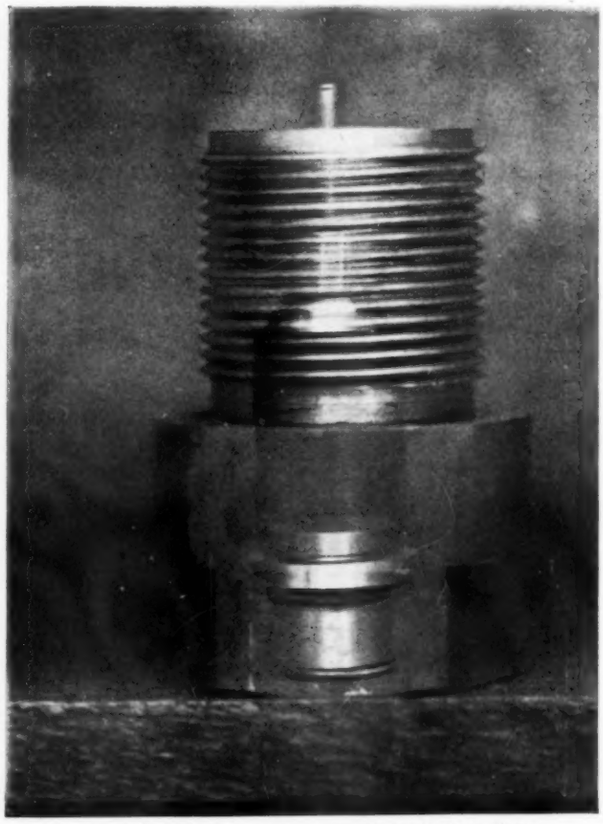


Fig. 24. Phantom View of Piezo-electric Gage.

Comparative Accuracies

It has been known for a long time that the pressure obtained from the crusher gage was in error from 15 to 20 or more per cent; however, it affords a cheap and easy method of obtaining comparative pressures and may be readily used by Artillery troops; so that, for the use for which intended it may be expected to be continued in use until one of more accuracy and as easily operated is devised.

The tests with lead cylinders for recording low pressures indicated that for pressures below about 8000 lbs. per sq. in. the lead cylinders gave much more uniform results than did the copper cylinders and that these cylinders used in minor caliber pressure gages should be utilzed for measuring these pressures. The difference between the

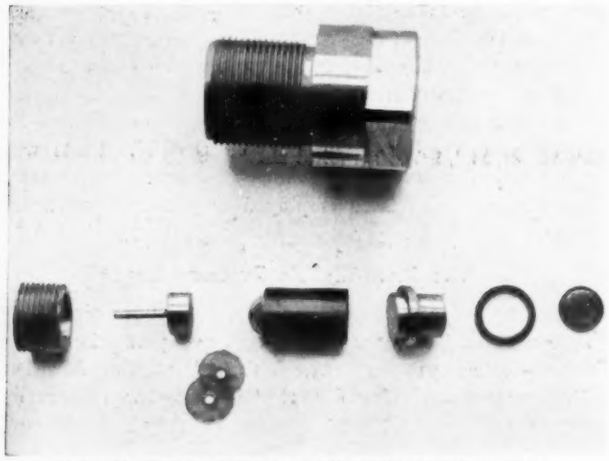


Fig. 25. View of Disassembled Piezo-electric Gage.

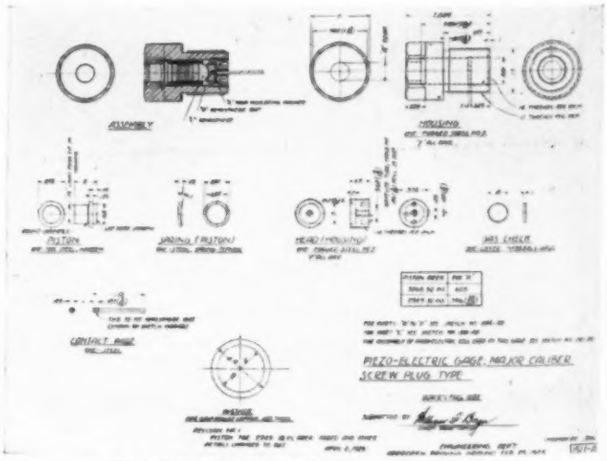


Fig. 26. Design of Piezo-electric Gage.

true pressures and the gage pressures is quite similar to that encountered in using the copper cylinder, it is readily established by means of the Piezo-electric gage and due allowance in interior ballistic calculations is easily made.

With the Piezo-electric pressure gage, results, accurate

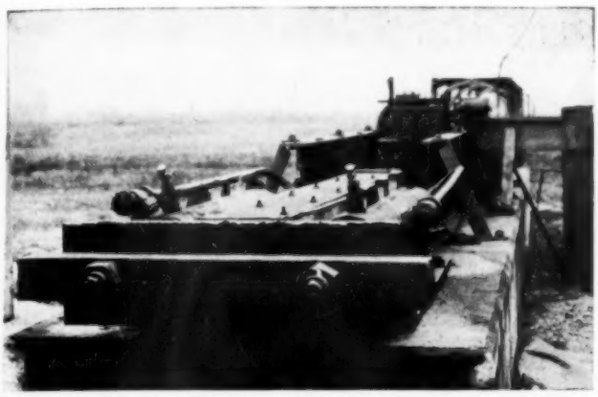


Fig. 27. 240-mm. Howitzer Free Recoil Program — Recoil Cylinders and Breech with Connections for Piezo-electric Gage in Mushroom Head and Primer Circuit.

to within about 500 lbs. per sq. in. have been obtained and it is believed that shortly this may be reduced to an error of only about 100 lbs. per sq. in.

Inertia effects in this gage are reduced to practically nothing, the motion of parts in the gage being only the actual compression of the parts of the gage under pressure. When the copper crusher gage and the Piezo-electric gage are used simultaneously in the breech the maximum pressures obtained with the Piezo-electric gage are from 15 to 20 per cent. higher than with the crusher gage, and the quicker the powder the larger is the difference in results.

Combined Applications of Various Instruments

The recording camera of the Solenoid Chronograph and the Piezo-electric gage, together with other instruments devised at the Aberdeen Proving Ground and the Bureau of Standards, have been combined on a number of experiments which are destined to have a far reaching effect on ordnance theory and design. Among these are the 240-mm. Howitzer free recoil program closed chamber experiments, the air resistance programs, blast determinations, and the trunnion reaction of aircraft armament. Since the summer of 1922 these investigations have been conducted by Mr. R. H. Kent; the results of these tests included herein have been taken from his reports.

The 240-mm. Howitzer Free Recoil Program

The howitzer is so mounted as to recoil horizontally on roller bearings with but slight friction, its recoil being unchecked until after it has recoiled about five feet and is not further acted on by the powder gases, Figs. 27, 28, 29, and 30.

A fine wire placed in front of the primer is broken when the primer fires and (a) the time of this occurrence is indicated on the recording camera; the powder burns and (b) the time-pressure relation is recorded by means of a Piezo-electric pressure gage; a contact is provided which is opened the instant the projectile moves and (c) the time this takes place is recorded by the camera; as the projectile moves along the bore the rotating band touches electric contact points established at thirteen positions along the gun and the instants of passing are recorded on the camera, from which may be established (d) the velocity of the projectile. The gun is also provided with crusher gages at eleven positions along the bore so that (e) the time-pressure relation may be obtained therefrom

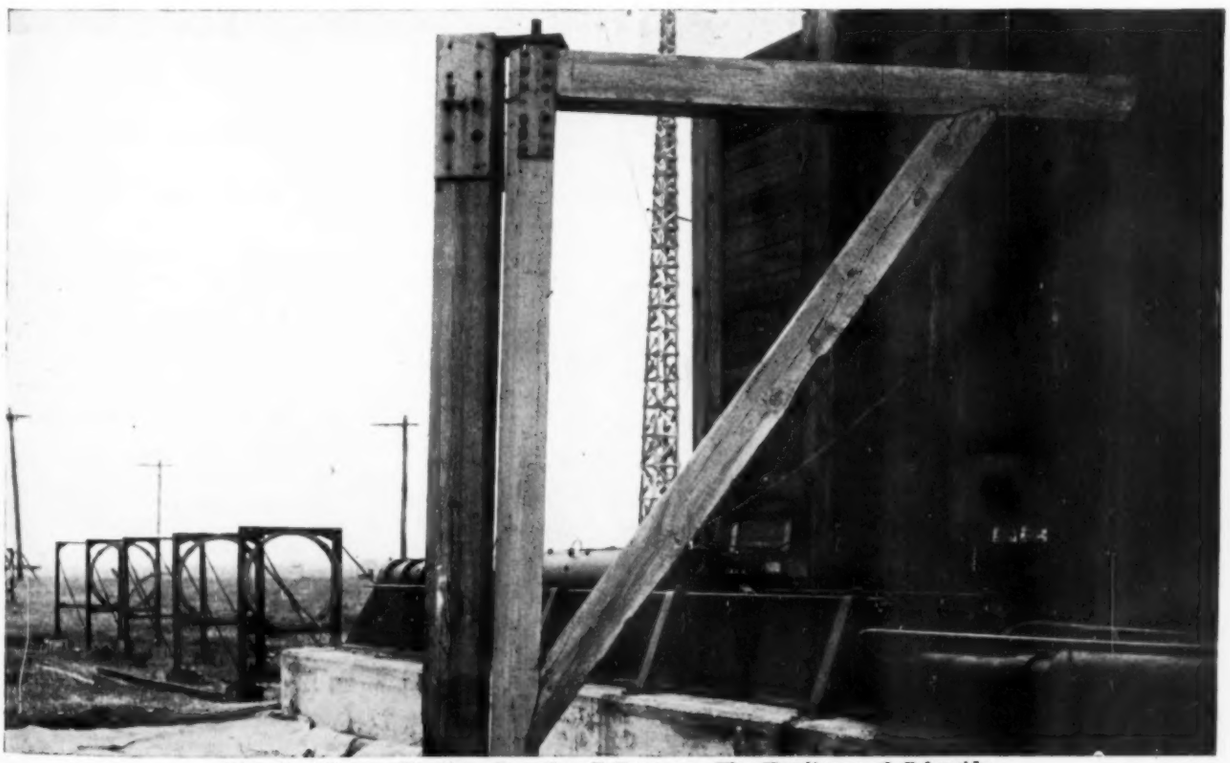


Fig. 28. 240-mm. Howitzer Free Recoil Program—The Howitzer and Solenoids.

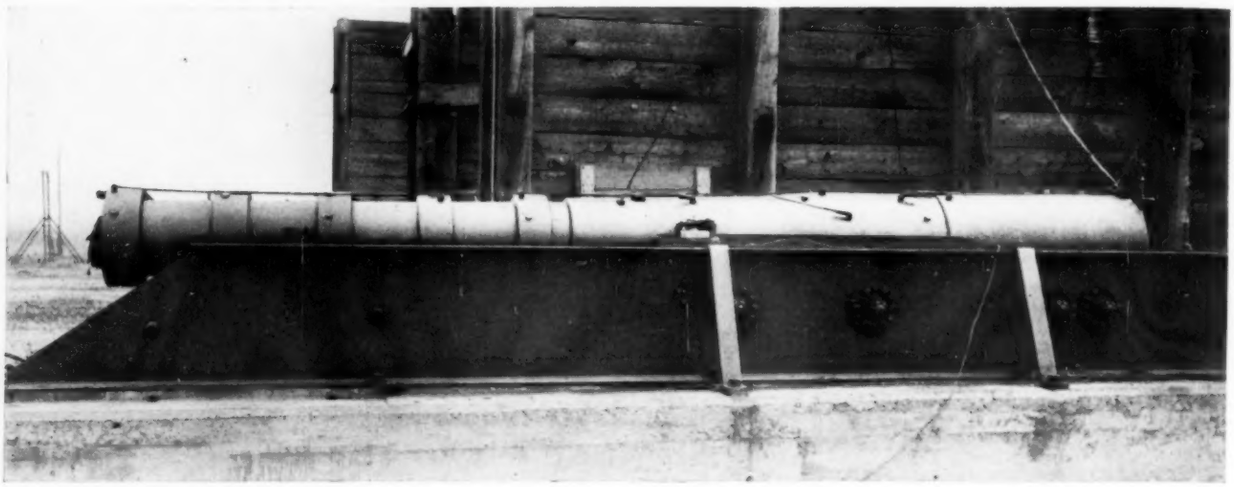


Fig. 29. 240-mm. Howitzer Free Recoil Program—The Howitzer with Recoil Contact Bar and Connections for Projectile Contacts and Bore Gage.

and a comparison made with the results from the Piezo-electric gage in the powder chamber. A series of electrical contacts is provided on the side rails over which passes a single contact point as the howitzer recoils, in this way (f) the velocity of recoil is obtained on the camera; and finally as the projectile leaves the howitzer (g) its velocity is obtained by means of the Solenoid Chronograph.

Results Obtained

Besides obtaining data for the purpose of constructing cannon with more accurate knowledge of existing conditions as a basis, the apparatus used permits of a more thorough analysis of conditions than has been possible heretofore from the viewpoint of interior ballistics, so that additional facts and relations are obtainable, as follows: (h) the starting resistance of the projectile, (i) the resistance to travel of the projectile, (j) the ratio of the specific heats of the gases, (k) the rate of burning of the power per unit surface as depending upon the pressure and temperature, (l) the co-volume of the molecules of the gas, (m) the energy of the powder, (n) the average exit velocity of the gases.

It has been determined that the starting pressure is far below the values of 2500 to 3000 lbs. per sq. in., which are based on the results of pushing a projectile through a gun, at least for the 240-mm. howitzer, and also that the band resistance is but slightly above 1000 lbs. per sq. in. and increases with the pressure.

The ratio of the specific heats of the gases, λ, as determinded, are dependent upon the assumed value of the co-volume; if this is known correctly it is believed that this ratio may be determined with a probable error of 0.023. The co-volume is being determined independently by closed chamber experiments, the closed chamber being a modified obsolete gun.

Considerable light has been thrown on the question of the factors of pressure and temperature and the manner in which they affect the rate of burning of the powder. Most ballisticians use a factor for pressure only, but these experiments indicate that the temperature also must be considered in determing the rate of burning.

The energy of the powder given by the formula $E=\frac{pv}{\gamma-1}+\int pdv$ is readily compared with the energy as determined from the knowledge of the chemical reactions which occur, and with the co-volume known, the probable error of the determination from this formula would be about 2 per cent.

The table on the following page and Fig. 31 show some of the data obtained.

As work on this apparatus proceeded there was developed by Mr. R. H. Kent a method of utilizing the Piezo-electric pressure gage to determine maximum pressures only in cannon. The principle on which the method is based is, briefly: The charge from the gage, developed by the pressure, passes through a vacuum tube valve to a condenser. The tendency to flow from the condenser to the gage after the maximum pressure has been reached is resisted by the valve. The charge remaining on the condenser corresponds approximately to the maximum pressure, which may be measured by discharging it through a ballistic galvanometer. This method gives results with great accuracy and is capable of being employed, using several condensers, to obtain a time-pressure relation in a gun.

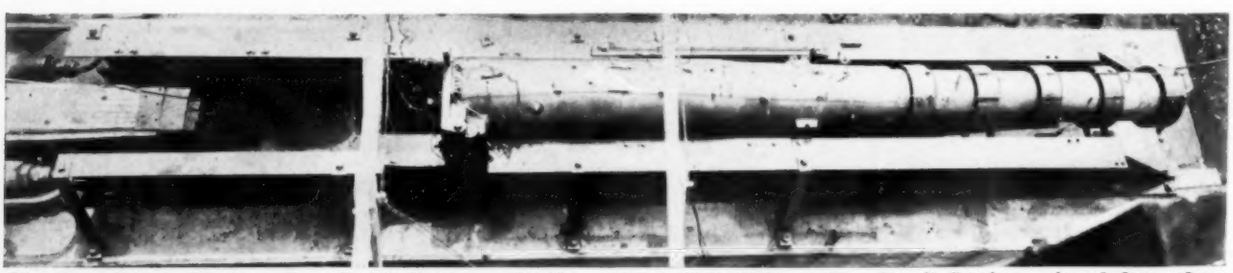


Fig. 30. 240-mm. Howitzer Free Recoil Program—Howitzer (Mod. 1918, M I) on Free Recoil Carriage, viewed from above.

Table 1—Resumé of Results of Firings of 240-mm. Howitzer on Free Recoil Carriage.

Round	Wt. of proj. lbs.-oz.	Wt. of charge, lbs.-oz.	Web thickness, inches	Vel. of proj. extrapolated back to muzzle from solenoids, ft. per sec.	Value of resistance coefficient, $C_R \times 10^{-5}$	Maximum velocity of recoil, ft. per sec.	Average exit velocity of powder gases computed from recoil velocity, ft. per sec.	Maximum pressure computed from recoil data, lb. per sq. in. $\times 10^{-3}$	Maximum pressure computed from proj. contacts, lb. per sq. in. $\times 10^{-3}$	Maximum pressure computed from Piezo-electric gage, lb. per sq. in. $\times 10^{-3}$	Maximum pressure from coppers in breech O. I. C., lb. per sq. in. $\times 10^{-3}$	Maximum pressure from coppers in breech, I. C., and their initial compressions, lb. per sq. in. $\times 10^{-3}$	I. C.	Maximum pressure from coppers along bore zero, I. C., lb. per sq. in. $\times 10^{-3}$	Time from firing of primer to start of proj., milli-seconds	Starting resistance, lb. per sq. in. $\times 10^{-3}$	Average resistance (distance), lb. per sq. in. $\times 10^{-3}$	value of exponent n of rate of burning $\left\{\frac{dM/dt}{S} = KPn\right\}$
12	357- 2	3- 0	0.0234	.....	.....	9.4	.....	3.24	3.22	4.12	3.2	.....	.....	3.9	48.819	0.5	.....	.....
13	360- 0	10- 0	0.0234	871	35.2	.....	.....	10.60	.....	15.42	11.8	.....	.....	17.2	.....	0.5	.....	.....
14	358-10	12- 8	0.0234	986	.....	.....	.....	.....	.....	17.7	15.25	16.7	14	22.5	.....	0.5	.....	.....
15	354-13	16- 8	0.0234	1169	.....	.....	.....	.....	.....	26.7	21.4	22.35	18	30.1	.....	0.5	.....	.....
16	354- 0	21-10	0.0234	1361	28.2	.....	.....	.....	.....	38.2	30.7	30.7	24	55.2	.....	0.5	.....	.....
17	358- 0	21-10	0.0234	1348	44.6	.....	.....	.....	38.0	39.9	30.25	31.34	24	49.5	.....	0.7	0.75	0.754
18	354- 0	10- 0	0.036	822	35.7	19.6	4082	.....	9.25	10.80	7.7	.....	.....	11.5	31.591	0.5	1.00	0.703
19	355- 0	14- 8	0.036	1021	85.3	24.65	3782	12.93	12.00	14.20	11.6	.....	.....	19.2	.....	0.5	1.14	0.790
20	358- 8	20-15	0.036	1270	.....	25.7	.....	22.6	21.75	24.4	18.95	18.8	14	30.5	.....	0.5	1.35	0.940
21	355- 8	25- 0	0.036	1406	74.2	37.2	5197	.....	26.0	28.2	22.9	23.65	18	35.3	.....	0.6	1.48	.....
														Mean..	.....	0.80		
														M. D.	.....	0.075		
														P. E. (	mean.	0.032		

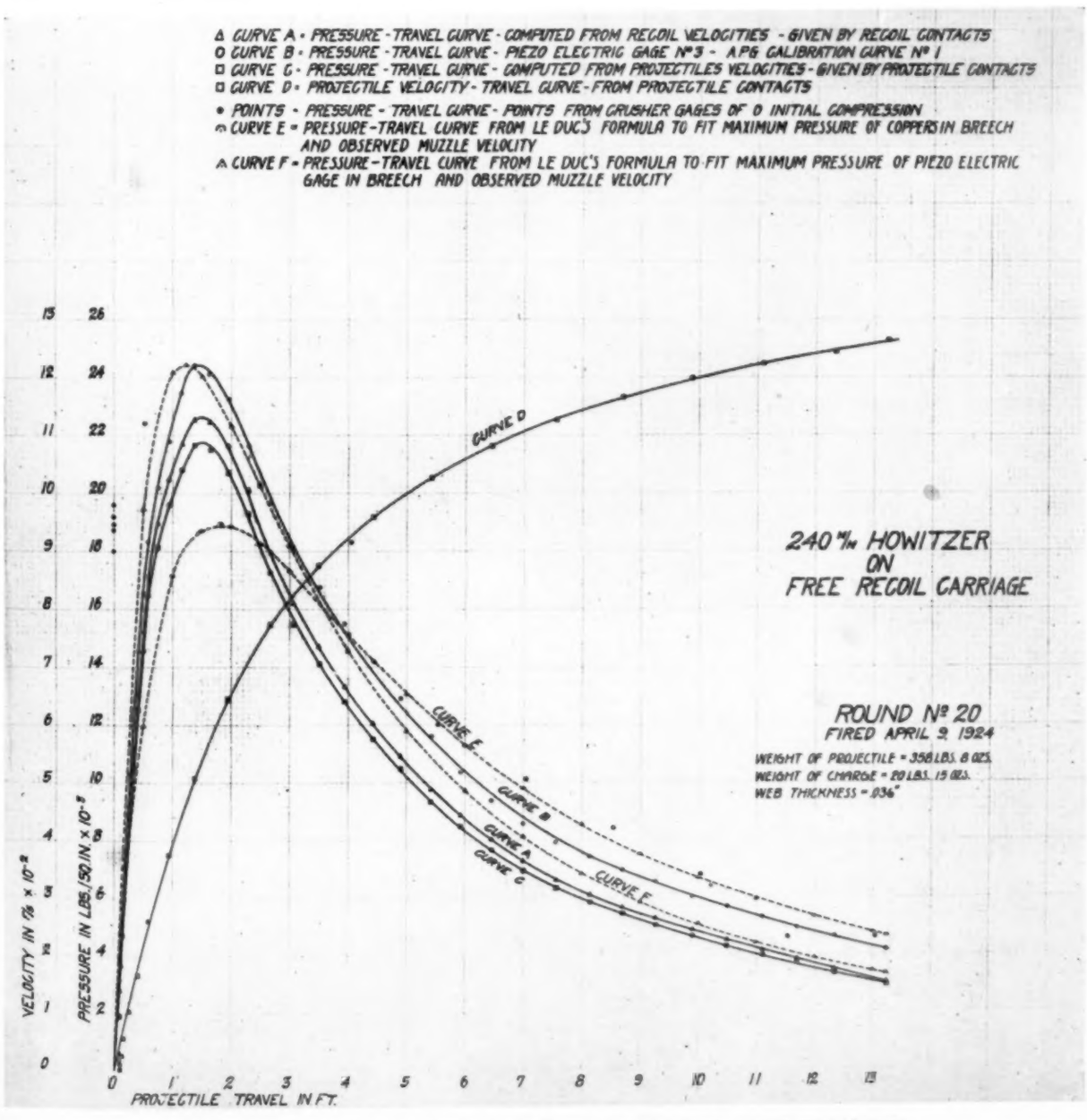

Δ CURVE A = PRESSURE - TRAVEL CURVE - COMPUTED FROM RECOIL VELOCITIES - GIVEN BY RECOIL CONTACTS
O CURVE B = PRESSURE - TRAVEL CURVE - PIEZO ELECTRIC GAGE Nº 3 - A.P.G. CALIBRATION CURVE Nº 1
□ CURVE C = PRESSURE - TRAVEL CURVE - COMPUTED FROM PROJECTILES VELOCITIES - GIVEN BY PROJECTILE CONTACTS
□ CURVE D = PROJECTILE VELOCITY - TRAVEL CURVE - FROM PROJECTILE CONTACTS
• POINTS = PRESSURE - TRAVEL CURVE - POINTS FROM CRUSHER GAGES OF 0 INITIAL COMPRESSION
CURVE E = PRESSURE - TRAVEL CURVE FROM LE DUC'S FORMULA TO FIT MAXIMUM PRESSURE OF COPPERS IN BREECH AND OBSERVED MUZZLE VELOCITY
CURVE F = PRESSURE - TRAVEL CURVE FROM LE DUC'S FORMULA TO FIT MAXIMUM PRESSURE OF PIEZO ELECTRIC GAGE IN BREECH AND OBSERVED MUZZLE VELOCITY
240 M/M HOWITZER ON FREE RECOIL CARRIAGE
ROUND Nº 20
FIRED APRIL 2, 1924
WEIGHT OF PROJECTILE = 358 LBS. 8 OZS.
WEIGHT OF CHARGE = 20 LBS. 15 OZS.
WEB THICKNESS = .036"
CURVE D
CURVE E
CURVE B
CURVE A
CURVE C
CURVE F
VELOCITY IN FS. × 10⁻²
PRESSURE IN LBS./SQ. IN. × 10⁻³
PROJECTILE TRAVEL IN FT.

Fig. 31. Some of the Data Obtained by 240-mm. Howitzer Free Recoil Experiments.

Fig. 33. Cardboard Records of Air Resistance Firings.

Air Resistance Program

The range used for determining the air resistance of artillery projectiles consists of a series of frames designed to hold large sheets of cardboard and frames for holding coils which are connected to the Solenoid Chronograph. A series of firings embracing a number of different velocities is made with the projectile the resistance function of which is to be determined. Its retardation is obtained from the velocity measurements made, and its yaw and stability from the record it makes when it passes through the cardboard screens. Very satisfactory and comprehensive results have been obtained on this range which have permitted a thorough knowledge to be gained of the effect of various modifications in shape of projectile bases, rotating bands, and ogives. This knowledge has made possible better projectile design and has broadened the theory of exterior ballistics applicable to modern shaped projectiles.

This range and some representative cardboard records obtained are shown in Figs. 32 and 33.

Fig. 32. Range at Aberdeen Proving Ground used for Determining Air Resistance of Artillery Projectiles.

Fig. 34. Early Type of Blast Meter.

Measurement of Blast

Blast meters of various designs have been used at Aberdeen Proving Ground for some years which give rough comparative measures of the blast effects of guns

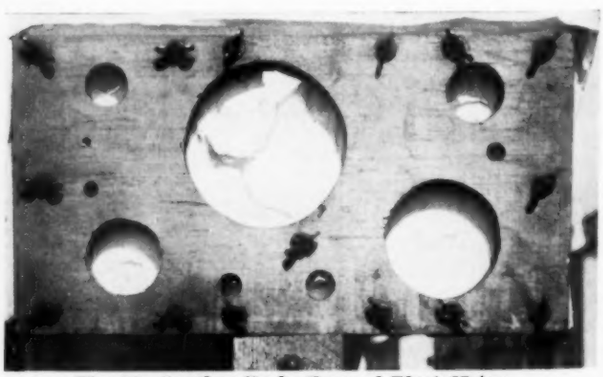


Fig. 35. Another Early Type of Blast Meter.

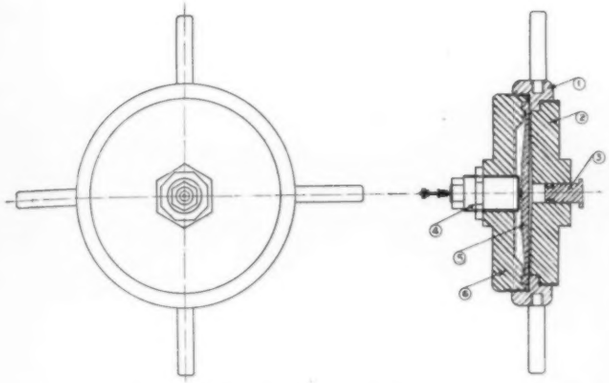


Fig. 36. Blast Meter Designed at U. S. Bureau of Standards.

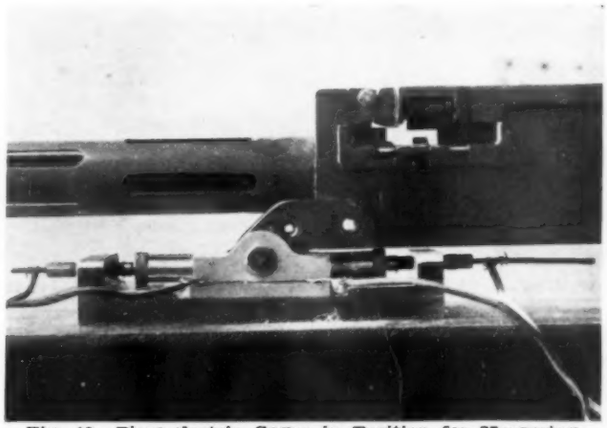


Fig. 40. Piezo-electric Gages in Position for Measuring Trunnion Reaction.

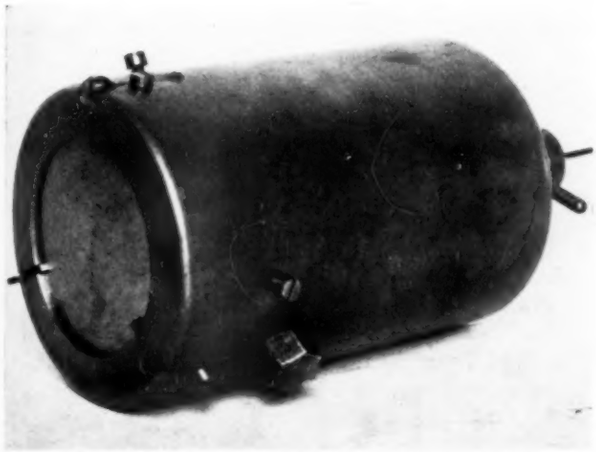


Fig. 37. Piezo-electric Blast Meter—Exterior View.

Fig. 38. Piezo-electric Blast Meter—Disassembled View.

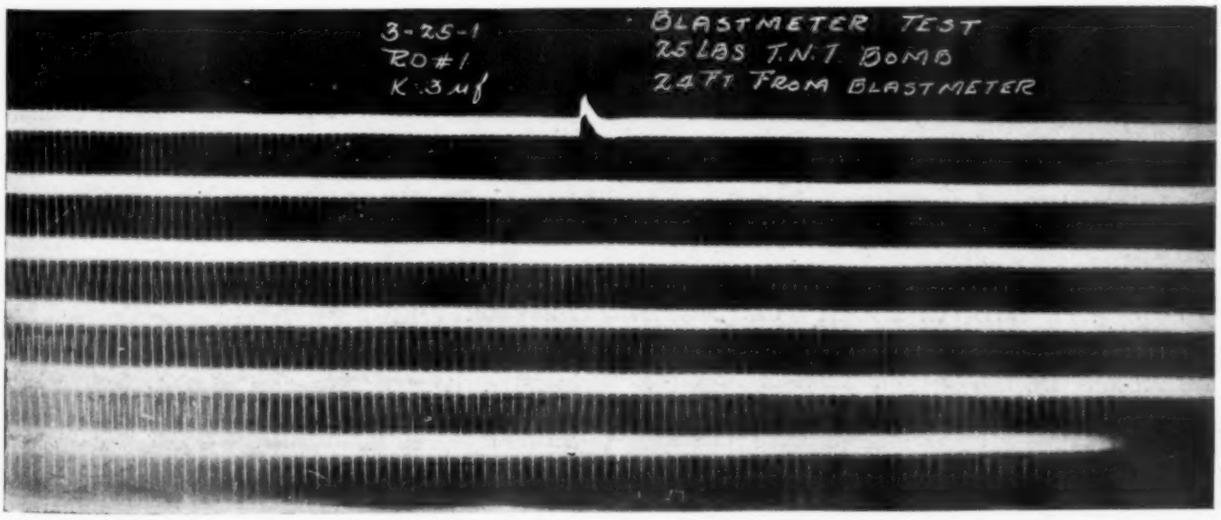


Fig. 39. A Record Obtained with Piezo-electric Blast Meter.

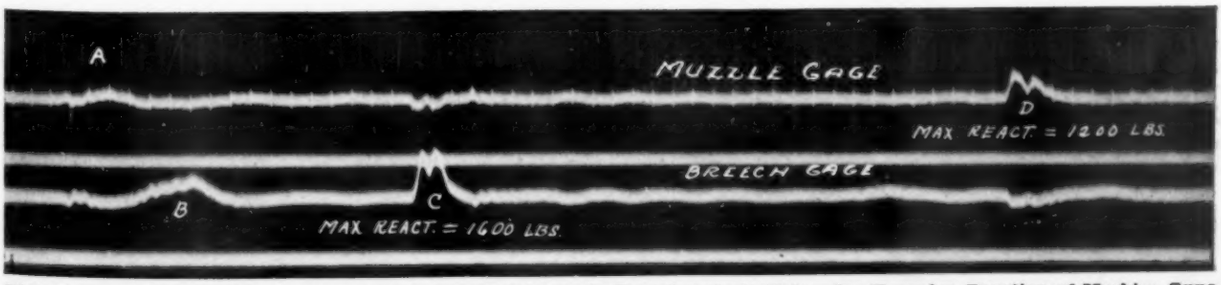


Fig. 41. Pressures Recorded by Piezo-electric Pressure Gages in Experiments to Determine Trunnion Reaction of Machine Guns.

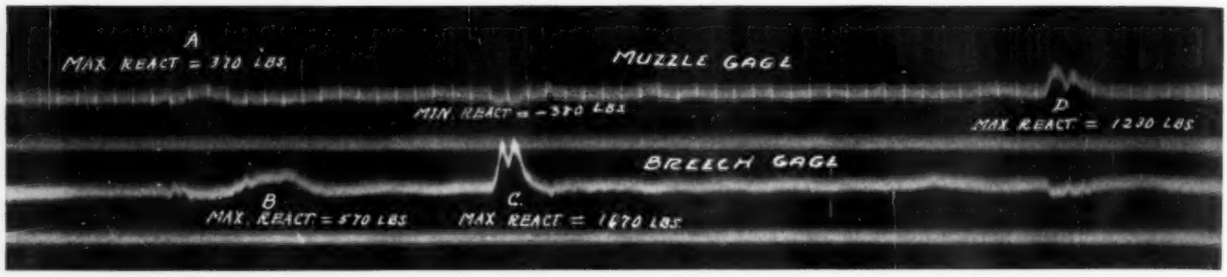


Fig. 42. Pressures Recorded by Piezo-electric Pressure Gages in Experiments to Determine Trunnion Reaction of Machine Guns.

and projectiles. One of these consists of small tight cylinders made of wood of various cross-sectional areas, which are set up on a horizontal board, Fig. 34. The larger blast the larger is the diameter of the cylinder which is overturned, those of smaller diameter overturning, also. Another blast meter consists of a board provided with holes of different diameters across which are pasted pieces of paper, Fig. 35. A blast of one strength will break the paper over all holes down to a certain dimension, a blast of greater strength will break all papers down to a certain smaller dimension. These methods are comparative only, are not refined, and give no accurate absolute values of the blast effects.

In order to provide a better method of measuring this effect Dr. Eckhardt at the Bureau of Standards undertook to design a blast meter, Fig. 36, for the Ordnance Department. The diaphram was ⅜-inch steel, 12 inches in diameter. In operation the meter is mounted rigidly with the diaphram facing the source of pressure and its center approximately on a level therewith. The effect was recorded through the agency of the Piezo-electric pressure gage. This was tested but was considered not satisfactory due to low mechanical frequency, about 1000 cycles per second. A new design was then made by Mr. R. H. Kent at Aberdeen Proving Ground and tested. This is shown in Figs. 37 and 38.

In this design the main features it was desired to incorporate were, (a) high natural frequency, (b) the use of a Piezo-electric pressure gage of the same type as those used in guns, and (c) adaptability for the use of lead crusher cylinder instead of the Piezo-electric cell. This type of instrument was quite successful, results indicating that with a vibrator in the recording oscillograph having a frequency of 12,000 cycles per second that it should be possible to measure blasts as low as 15 lbs. per sq. in. with a probable error of about 1 per cent. When measuring disturbances of less suddenness, where a vibrator of low frequency could be used it should be possible to record a blast of only 5 lbs. per sq. in. with equal precision and the meter should be sensitive to blasts of as low as ½ lb. per sq. in. One of the records obtained is shown in Fig. 39.

Trunnion Reaction Experiments

The reaction of machine guns and 37-mm. guns against their supports was undertaken in order a furnish accurate data for use in designing mounts for airplanes and ground use. For this purpose the trunnions of each gun being tested were supported by blocks which were free to slide back and forth under the force of recoil and counter-recoil, such motion being restricted by the interposition of two firmly fixed Piezo-electric pressure gages, Fig. 40. The e.m.f.'s produced by the gages were amplified and then recorded on the solenoid camera. Pressures as indicated in Figs. 41 and 42 were recorded.

A great amount of the information which has been obtained from the experiments and apparatus described in this article may be stated in only a few words, the work necessary to obtain the data may have involved several months' serious investigative thought and experimentation, and a large expenditure of funds. The work undertaken, original research work as it is, adds immensely to our ballistic knowledge and the benefit derived therefrom when applied to guns and ammunition in case of a national emergency would make the cost seem insignificant.

An American Team for International Matches, 1927?

Brig. Gen. M. A. Reckord, Md. N. G.

AMERICA'S colors were dragged in the dust, figuratively speaking, on the rifle range at St. Gall, Switzerland, on the 14th of August last year, when the Swiss Rifle Team defeated our team for the championship of the world.

It is most important that America send a rifle team of championship caliber to Europe next year to retrieve our losses. The National Rifle Association of America has already begun work toward the attainment of this very worthy end.

A hercuIean effort is necessary if we are to defeat the Swiss in the spring of 1927. We must immediately assemble the prospective candidates at central points for preliminary training. The best shots must then be assembled for the final tryout and the team selected and transported to Rome, where the 1927 shoot will be held.

To accomplish all the above requires considerable effort and some financial assistance. It is for this purpose the National Rifle Association is at the present time bringing this matter to the attention of the citizens of the country and giving them an opportunity to assist, in a small way, by contributing to the fund necessary to defray the expenses of the team. Concerted effort on the part of those who believe in preparing the youth of the nation for its defense will make it possible for America to be represented at Rome in 1927, by a team of real championship caliber.

Editorial

Eight Years of Constructive Accomplishment

THE Eighth Annual Meeting of the Army Ordnance Association at Aberdeen Proving Ground, Md., October 8, 1926, was by and large the most successful yearly gathering of the organization since its establishment. In point of attendance it far outranked all previous meetings. A conservative estimate of the number in attendance has been placed at 3600. The program of demonstrations was the most comprehensive, most interesting, and best conducted of any of these now well known affairs.

This success is due to a number of causes. First and foremost, the fine cooperation from the War Department generally, the Hon. Dwight F. Davis, Secretary of War, the Assistant Secretaries of War and Chiefs of Branches, was noteworthy. Likewise the active aid of Maj. Gen. C. C. Williams, Chief of Ordnance, and his staff, contributed greatly in making the program of such appeal and interest to all who were in attendance. Further, the efficieney and dispatch with which the entire day's performance was carried on by Lt. Col. C. M. Wesson, Commanding Officer, Aberdeen Proving Ground, and his staff, was a remarkable tribute in itself to the organization at the Proving Ground and by the same token a fine testimonial to the friends of industrial preparedness who were there.

It is but natural to ask why is this ever-growing spirit of interest and cooperation which is today so evident on the part of the War Department and of such organizations as the Army Ordnance Association and its guests which included members of the National Association of Manufacturers, the National Industrial Conference Board, the Reserve Officers' Association of the United States, and the American Society for Steel Treating?

The answer is not difficult to find. The theory of industrial preparedness is thoroughly sound and American. It is sound because it endeavors to keep in perfect balance the two larger factors of adequate defense. It is sound because it places on an equal plane of importance munitions power and man power. It is sound because it is a sensible application of war-time experience in the solution of a problem that unfortunately in the past has been greatly overlooked. It is American because it aims at distributing a responsibility equally and properly just where that responsibility belongs.

The efforts of the Government today for industrial preparedness are most praiseworthy. It has overcome one of the greatest stumbling blocks of the World War by decentralizing the agencies of procurement. It has made a logical apportionment of the requirements that must be met by American industry to these decentralized agents, and it has provided the necessary machinery for a continuous and ever current solution of this great problem. To those who framed the National Defense Act of 1920 and insisted against great odds for the inclusion of our industrial preparedness activities therein, our own generation as well as those of years to come will acknowledge a deep debt of gratitude. To the officials who have been charged with the task of carrying out the industrial preparedness provisions of the National Defense Act and who have performed the duty so capably and so well, is also due the credit and praise that goes with every big job well done.

Side by side with the official efforts of the Government in this respect go the activities of the Army Ordnance Association. It aims to keep alive an interest in and knowledge of munitions developments and requirements. It endeavors to do so by supplementing in a strictly unofficial way the official activities of the Government. It aims to help wherever it can, and by keeping together a body of several thousand interested individuals it believes that it is maintaining in close contact our first line of munitions reserve. The degree in which it has accomplished this objective is not for us to say. We can only point with a great deal of pride to the fact that after eight years this organization has established itself in the minds of thinking people in a very definite manner. The idea was, until 1919, entirely new.

It is our earnest hope that the two great factors of preparedness, man power and munitions power, may ever go hand in hand. One cannot succeed without the other. Today they are in closer balance than ever in the past.

"Industrial Preparedness—A World Declaration That We Want Peace and Intend to Have It"

TO our mind there has been no more forceful nor more direct statement on industrial prepardeness in recent years than that of the Assistant Secretary of War, Hon. Hanford MacNider, in his address at the Industrial Preparedness session of the recent Annual Convention of the National Association of Manufacturers in New York City. Colonel MacNider has the happy faculty of expression by which he lauds the figurative smashing blow right between the eyes. The following statement of the case as given by him is a trenchant exposition of the ultimate aim of industrial preparedness—a doctrine that we "want peace and intend to have it." He presented the matter in this way:

"The newest and most spectacular development in the whole national defense structure since the Great War is not strictly speaking of a military nature. Strangely enough, there have been no revolutionary additions to the mechanics of warfare in the last eight years and, though emphasis may have been given to the development of certain arms, our armies would go to war tomorrow with

more or less the same equipment which they carried when the Armistice found them stretched across the North of France.

"That is—provided we could get that equipment, and right there is where the great new activity of the War Department would enter the picture—namely, the industrial mobilization plan which, under the National Defense Act of 1920, is a mandate upon the Office of The Assistant Secretary of War.

"The ramifications of the Industrial Preparedness structure are manifold. When we remember that our military establishment used some seven hundred thousand odd manufactured articles in the last emergency, we have some idea of the problem. It is our task to plan for the manufacture of every such item—all the way from the raw material to the finished product. We must not only meet the overwhelming demand of our armies which may take the field, but we must leave undisturbed the normal requirements of the nation.

"The civilian population's necessities cannot be cut off in order to supply those actively engaged in the nation's defense. On the contrary, both those in uniform and out will be giving equally, and production must meet the increased demands of a hundred million people rising as one in a super-human effort to meet a great emergency.

"That is our problem, and we have turned to Industry to show us the way. The response has been eminently worthwhile. Our program has been placed largely in the hands of Industry, and the great structure of emergency insurance plans which has been erected stands today as our best assurance against aggression—our best assurance for what every real American desires for America—peace and continued peace.

"For the first time those charged with the national defense have been instructed to give to Industry its rightful and all important place in the program for the national protection. It represents the first tangible effort to decentralize in peace the responsibility which after all belongs to Industry, and which in emergency has always been promptly presented to it without warning or opportunity to equip itself for the terrific strain of a war load. Now the requirements are clear. Time, the most valuable of all possible allies, is with us. We can work out together our needs and your facilities.

"None of us wants war. As far as that goes, none of us wants hurricanes. If we are to cope with such emergencies, we must underwrite in advance any possible catastrophe. A striking example of such foresight has just been exemplified here in America's greatest city. The Hon. James J. Walker, Mayor of New York, realizing his responsibilities in the premises, only recently appointed an important group of civic leaders to study not only our problems but New York City's own. It was ready and promptly went into action to organize help in the Florida disaster. We trust that his initiative will be followed by the mayors of our other great cities.

"The increasing interest all over the nation in our Industrial Preparedness is a frank declaration to the world that we not only want peace but that we intend to have it."

Well said, Colonel MacNider. The Army Ordnance Association is with you to a man.

Scrutinizing the Ordnance Dollar

A GREAT many people whose zeal for national defense often prompts them to decry the seemingly parsimonious attitude of the Congress in appropriating funds for the military and naval Services in peace times always hark back to those hackneyed statistics comparing our huge national yearly chewing-gum and silk-stocking purchases to the relatively minute sums allotted for defense. The argument was not bad when new, but it is now so old that the average schoolboy knows it as well as he does the dates of Bunker Hill and Yorktown. Even when new, the comparison neither reduced the consumption of chewing gum or lingerie nor raised the national defense appropriations: so citing the enormity of our "frivolities fund" takes its place as an argument with the Cross of Gold speech of 1896, the Referendum and Recall of a later day, and others.

Probably those same enthusiasts have given little, if any, thought to the very methodical way in which funds for the national defense are arrived at. Maybe a great many who have felt they had a fair idea of the process thought there were still in vogue the same hit and miss tactics that characterized the Governmental estimates of former days. If there be such we suggest that they read carefully the article by Maj. C. T. Harris, Jr., Ord. Dept., U. S. A., in the current issue of this journal.

This thing of getting the Ordnance dollar from Congress is no haphazard undertaking. It is, rather, as careful and painstaking and scientific a process as the most technical purpose for which any particular Ordnance dollar is spent.

Up from its very first step, the whole system is one of scrutiny. Each new cook in the process who tries a hand at the pie must be convinced that the seasoning is just right. And the result after a dozen or more connoisseurs have had their sense of good taste satisfied should be a delicacy—small though it be—of the proper proportions to suit the most fastidious.

We do not mean to defend the amounts that have been appropriated for munitions development and manufacture in recent years. The point we emphasize is that the method now in vogue of requesting funds for national defense seems to be as systematic and accurate as that used by any of our great industrial organizations. It is a concrete example of putting business in government.

This fact must stand out head and shoulders over the whole structure: once the War Department program is established for a given year and the Ordnance program for the same period is accordingly determined, every dollar of the taxpayer's money that goes for munitions preparedness is subjected to a scrutiny by the Executive and Legislative branches of the Government that is an absolute guarantee of the propriety and need for the expenditure. There is no guess work; no asking for twice your needs in anticipation of receiving one-half and thus having enough; no hit and miss. The business is sound from start to finish. The Ordnance dollar is asked for at its face value and is spent on the same basis. And it is good for the taxpayer to know it. If he desires that more be spent he will, in his own good time, see that it is done. Meanwhile he can rest assured that the Ordnance dollar, viewed with microscopic exactitude before it is given, is just as carefully spent.

Professional

Development of Solenoid Chronograph

CHICAGO, ILL., October 13, 1926.

Editor, ARMY ORDNANCE:

I have read with great interest the excellent description by Major Ford on "Instruments for Making Ballistic Determinations and Some Results Obtained at Aberdeen Proving Ground," Part I, which was published in the September-October issue. For the sake of historical accuracy, may I be permitted to make a correction of a date mentioned in the discussion and to add a few facts which may perhaps be interesting to your readers?

Major Ford states that the Ordnance Department conducted experiments at Sandy Hook in 1918 involving the use of solenoids and coils to record projectile velocities. In April, 1917, while I was on the staff of the physics department at the University of Minnesota, I submitted several suggestions to the Commanding Officer of Sandy Hook Proving Ground which had for their object the elimination of the wire firing screens used in the Boulengé chronograph. One of the suggestions was the use of the solenoid screen.

The plan differed somewhat from that finally adopted. Instead of magnetizing the projectile and firing it through a single coil it was my idea to use two closely coupled coils, one of which was to carry direct current, thus creating a steady magnetic field about both coils. Firing the projectile through the two coils would induce a current in the secondary coil and the plan was to utilize this current for operation of the Boulengé chronograph.

In the summer of 1917, in connection with an eastern trip, I stopped at Sandy Hook Proving Ground and discussed the matter with Colonel Ruggles. Colonel Ruggles was much interested, and in order to make it possible for me to develop the ideas I had proposed he made application for an appointment under which I might carry on the work. In the meantime, to test the feasibility of the suggestions I remained at Sandy Hook for several days and together with Major Lindh constructed a two-coil solenoid in the machine shop at Sandy Hook.

In August, 1917, we succeeded in getting everything ready for test. The primary coil was supplied from the instrument room with current from the storage batteries used in connection with the Boulengé chronographs. The underground line extending to the "front" left much to be desired in the way of insulation, but we did succeed in sending a current through the coil of about half the desired strength. A line was run back to the instrument room from the secondary of the coil and a pair of telephone receivers connected to it. A number of shots were fired through the solenoid and Major Lindh and I both distinctly heard the click in the receivers as the projectile passed through the solenoid.

In October, 1917, the appointment for which Colonel Ruggles had made application was made. Using the facilities of the machine shops of the Bureau of Standards I had two of the double solenoid coils made, and on December 9, 1917, using additional apparatus kindly supplied by the Western Electric Company, we succeeded in operating the Boulengé chronograph by means of the solenoids. No actual measurements were made, but the chronometer and registrar armatures were successfully released.

On December 15th, a cold Saturday afternoon, with a detail of men not at all enthusiastic about the experiments, we operated three Boulengé chronographs with the solenoid screens in comparison with three others operated by means of the usual wire screens, both sets of chronographs recording the same round of ammunition. The solenoid screens, which at that time I designated "inductor" screens, operated perfectly and gave velocities which agreed fairly well with the velocities measured by the usual method. However, the marksmanship of the gun crew, either because of the cold weather or because of the dislike for the experiments, proved so poor that after four rounds had been fired the second inductor was struck by the projectile and damaged beyond repair.

About this time orders were issued to transfer all proving ground activities to Aberdeen and to commence proof firing there on January 1, 1918. Experimental facilities at Sandy Hook were poor. At Aberdeen they were entirely lacking. The only thing I could do under the circumstances was to return to Washington and work on the laboratory end of the development of other methods of measuring projectile velocities which had given promise. The Aberdeen chronograph, which, in crude form, had its inception at the Bureau of Standards, was tried in February, 1918, in one of the lookout towers behind the firing line. Major Loomis, who had charge of the development work at Aberdeen, took such an interest in this chronograph and made such major contributions to its design that it was a matter of only a few months before the instrument had been developed to its final form. Looking after the details of this development took so much of my time that the solenoid chronograph had to be abandoned "until some later time."

Most of the particulars which I have mentioned above regarding the inductor or solenoid chronograph are covered in detail in memorandum reports to the Ordnance Department, the latest of which is dated December, 1917.

In looking back to the events of 1917 and 1918 it appears almost certain that if there had been experimental facilities at Aberdeen Proving Ground in January, 1918, the solenoid screens would have been developed for routine operation of the Boulengé chronograph. The success in the final experiments at Sandy Hook indicated that a practical solution of the problem was merely a matter of refinement of details.

PAUL E. KLOPSTEG.

Tests on Delhi Tough Rustless Iron at Rock Island Arsenal

THE Ordnance Department recently secured two forgings of Delhi Tough Rustless Iron to be used experimentally in the manufacture of piston rods for hydro-pneumatic recoil mechanisms. These forgings were rough machined at the Watervliet Arsenal and then shipped to Rock Island Arsenal, where a piston rod for a 75-mm. Gun Carriage Recuperator, M 1897, has been manufactured from one of these forgings.

The stock used was annealed by the manufacturer, and was turned, ground and polished in this condition. A chemical analysis, Rockwell and Scleroscope test were made on the stock and the following results obtained: carbon .07 per cent., manganese .48 per cent., sulphur .012 per cent., silicon .23 per cent., chromium 18.14 per cent., Rockwell 86, Scleroscope 25.

The rod as received was 1½-inch diameter and was first rough turned to about 1-inch diameter, using a cut of ⅛-inch depth, with feed of .032-inch and surface speed of 48 ft./min. During rough turning, a cutting compound consisting of two parts mineral lard oil and one part sal soda was used. The material turned very easily, almost like common wrought iron, being very soft, and the slag seams were very fine. The roughing tool had a tendency to make a straight chip with a slight spiral in it. This was corrected by grinding tool with less rake and a lip on the point. Various feeds and speeds were tried, but the above feed and speed proved the most satisfactory except that the rod chattered when turning. To eliminate chatter, a second tool was placed on the opposite side of the work from the first tool and the depth of cut reduced to 1/16-inch per tool. The speeds and feeds were then changed to the following: surface speed 60 ft./min., feed .032-inch, depth of cut 1/16-inch per tool.

After the rod had been completely rough turned, it was indicated for alignment and had sprung .03-inch, which is not considered excessive due to amount of stock removed on such a small diameter.

In finish turning, it was found difficult to finish the rod smooth enough for lapping, although several kinds of tools were used. It was found that either a spring tool or a straight tool with a small flat ground on the nose of the tool, and using a speed of 120 r. p. m. and .041-inch feed, turned the rod satisfactorily for grinding. A lubricant consisting of two parts kerosene and one part lard oil, was tried when finish turning, but results with this lubricant were no better than with soda water.

When cutting the V-threads on the front end of the rod, the compound of the lathe was set to the proper angle of thread so the tool could cut only on one side. This is absolutely necessary because if the tool happened to cut on both sides it would gouge in and might possibly destroy the thread due to the softness of the metal. Pure lard oil was used as a lubricant while cutting the V-threads. The square threads on the coupler end of the rod were cut without any difficulty.

After the piston rod had been finished turned and threaded, it was out of alignment .01-inch, and therefore had to be straightened. The straightening was accomplished by placing the rod between centers of a Norton cylindrical grinder and straightened by the force of the hand.

The rod was then spotted for steady rest and ground to .004-inch over maximum diameter, first using a No. 3836 grain, grade "H," vitrified, aluminum Norton wheel. The surface speed used was 1,200 ft./min., and .0005-inch of material was removed per travel of table. The grinding with this wheel was not very satisfactory; it left small pit marks about .004-inch deep; the material ground very much like cast iron. A No. 3836 grain, grade "M," vitrified, Crystolon Norton wheel was then tried. Using the same surface speed and depth of grind as before, it was found that this wheel ground more freely and made an excellent finish.

After the rod was finished ground and inspected, it was pulled under a load of 15,600 lbs., a stress of 31,480 lbs. per square inch on the smallest section. The rod was observed to be without permanent elongation after the test.

After the pull test, the rod was placed between centers and polished by hand longitudinally while revolving 20 r. p. m. Three grades of emery paper were used, coarse No. 180, medium No. 220 and fine No. 320. The coarse grade was used with machine oil as a cutting lubricant and the two finer grades were used dry as the rod polished very satisfactorily. No emery cloth was used due to the softness of the material.

The finished rod was assembled in a recuperator and subjected to a firing test of 16 rounds, using the 16-lb. proof projectile and powder charges varying from 15½ ozs. to 1 lb., 10 ozs. After proof firing, the rod was pulled back in dynamometer and was found to have an abrasion, caused by coming in contact with the bronze collar, at rear of Belleville springs, at 1 o'clock position and 8 inches from the rear end of the rod. This bowing was caused by the momentum of the gun in the counter-recoil at the time of the slowing up of the piston rod due to the oil throttling in the regulator; this was determined by the position of the abrasion on the rod. The rod was straightened and reassembled in the recuperator, gymnasticated a number of times, was again examined and no indication of abrasion was noted, showing that bowing only occurs during firing conditions.

A piston rod for the recuperator of pack howitzer carriage, M 1923 E1, is now being manufactured from the second forging of the Delhi Tough Rustless Iron, using the methods found successful in the manufacture of the piston rod for the 75-mm. gun carriage. Upon completion, this rod will be similarly tested and proof fired.

Lieut. G. T. Rowland,
Ord. Dept., U. S. A.
Rock Island Arsenal.

Unserviceable Ammunition to Be Exchanged

THE Act of Congress, approved on June 1, 1926, dealing with the exchange or conversion into usable form, of deteriorated and unserviceable ammunition and components, has been published by the War Department in a current bulletin (No. 6) "for the information and guidance of all concerned."

The act authorizes the Secretary of War to exchange deteriorated and unserviceable ammunition and their components for ammunition or components in condition for immediate use. The Secretary also is authorized by the act, "to reclaim," such deteriorated and unserviceable am-

munition "as it may not be advisable to have so exchanged, and to pay either the whole or part of the cost thereof through the exchange of deteriorated and unserviceable components not desired to retain."

The full text of the Department's announcement follows:

"Act of Congress—Exchange, or conversion into usable form, of deteriorated and unserviceable ammunition and components.—The following act of Congress (Public No. 318—69th Congress) is published to the Army for the information and guidance of all concerned:

"An Act To authorize the Secretary of War to exchange deteriorated and unserviceable ammunition and components, and for other purposes.

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, authorized to exchange deteriorated and unserviceable ammunition and components thereof for ammunition or components thereof in condition for immediate use.

"Sec. 2. The Secretary of War is further authorized, by contract or otherwise, to reclaim, by revoking, reconditioning, or otherwise converting into usable form, either in complete rounds or in serviceable components, such deteriorated and unserviceable ammunition and components thereof as it may not be advisable to have so exchanged, and to pay either the whole or part of the cost thereof through the exchange of deteriorated and unserviceable components not desired to retain.

"Approved, June 1, 1926."

The Chief of Ordnance has been charged by the Secretary of War with carrying out the work enjoined by this act.

As the first action under this authority, there has been issued a circular proposal offering approximately 3,000,000 pounds of deteriorated smokeless powder for 8-inch guns. This is located at the Picatinny Arsenal, Dover, N. J., and will be exchanged either for new powder suitable for 75-mm. guns, or for strip brass suitable for the manufacture of .30 caliber cartridge cases.

Bids for this exchange will be opened on November 15th by the Commanding Officer, Picatinny Arsenal, Dover, N. J.

Soon there will be offered a considerable quantity of completely loaded large caliber shell, components of large caliber shell, and shrapnel, located at the Curtis Bay Ordnance Reserve Depot, Curtis Bay, Md., and Raritan Arsenal, Metuchen, N. J.

The gross market value of the merchantable scrap and explosive ready for immediate exchange at Picatinny, Curtis Bay and Raritan, will probably exceed $1,000,000. Other deteriorated and unserviceable ammunition will be offered from time to time.

Considerable interest in this plan has already been indicated by various commercial concerns.

New Antiaircraft Fire Control Instrument

THE combined Ordnance and Coast Artillery tests of new antiaircraft material at the Aberdeen Proving Ground have now reached their final stage and many of the new articles of equipment have proved highly satisfactory. One of these is the new fire control instrument for the use of the larger caliber guns against aircraft.

This instrument is so designed that, given the altitude of the plane, which is easily determined, the only action required is for one observer to follow the target's elevation and another to follow its direction, both through telescopes mounted on the instrument. The movements of these two telescopes control a mechanism which transmits electrically all firing data to the gun or guns. The data comprise the elevation and direction to be given the gun, so that the shell fired will intersect the path of the plane. The same instrument mechanically indicates the exact fuze setting that will explode the shell at the moment it reaches the point of intersection of the course of the plane and shell.

This fire control instrument mechanically moves pointers on the gun and on the fuze setting machine. All that is required of the gun crew is to keep the gun set at the elevation and direction automatically indicated and to feed the ammunition into the fuze setting machine and from there into the gun. The gun is a semi-automatic loader which has reached a rate of fire of 27 shots per minute.

Contributors to This Issue

MAJ. C. T. HARRIS, Jr., Ord. Dept., U. S. A., is executive assistant to Maj. Gen. C. C. Williams, U. S. A., Chief of Ordnance. For his meritorious service during the World War in connection with the development and production of ammunition, Major Harris was awarded the Distinguished Service Medal.

Miss Kathleen Bruce, Ph. D., is professor of history at William and Mary College, Williamsburg, Va. Dr. Bruce is known to readers of ARMY ORDNANCE for her articles on "Economic Factors in the Manufacture of Confederate Ordnance" which appeared in this journal during the past year.

Arthur LaMotte is manager of the Technical Section, Explosives Department, E. I. duPont de Nemours and Company, Inc., Wilmington, Del.

Maj. Stephen A. MacGregor, Ord. Dept., U. S. A., is the Ordnance representative on the Infantry Board, Fort Benning, Ga. The cross-country car, after development by the Ordnance Department, was submitted to the Infantry Board for service test.

Maj. C. H. Goddard, Ord. Res., U. S. A., is a leading small arms experts of the country. He is one of the founders of the Bureau of Forensic Ballistics, New York City, a scientific organization for the identification of fire arms and projectiles.

Maj. Arthur W. Ford is chief of the Ballistics Section, Aberdeen Proving Ground. Part I of this article on "Instruments for Making Ballistic Determinations" appeared in the September-October, 1926, issue of this journal.

Personnel

Edited by Major John A. Brooks, Jr., Military Personnel Section, Office of the Chief of Ordnance

Regular Ordnance Officers

REGULAR Officers of the Ordnance Department, U. S. Army, with station as of October 1, 1926, follow:

Adamson, Maj. K. F., Artillery Division, Office, Chief of Ordnance, Washington, D. C.
Aman, 1st Lt. J. L., Ordnance School, Watertown Arsenal, Watertown, Mass.
Ames, Col. T. L., Army War College, Washington, D. C.
Armstrong, Maj. Donald, Army Industrial College, Washington, D. C.
Atwood, Capt. F. J., Leland Stanford, Jr. University, Stanford University, Calif.
Aurand, Maj. H. S., Fort Mills, Philippine Islands.
Baird, 1st Lt. A. R., Ordnance School, Watertown Arsenal, Watertown, Mass.
Bandholtz, Maj. C. H., Massachusetts Institute of Technology, Cambridge, Mass.
Barnard, Capt. Clarence, Detroit District Ordnance Office, 802 Farwell Building, Detroit, Mich.
Barnes, Maj. G. M., Artillery Division, Office, Chief of Ordnance, Washington, D. C.
Barnes, 1st Lt. H. C., Panama Ordnance Depot, Corozal, C. Z.
Barr, Capt. R. S., Cincinnati District Ordnance Office, Room 714 Southern Railway Building, 4th and Sycamore Streets, Cincinnati, Ohio.
Barroll, Capt. M. K., Aberdeen Proving Ground, Md.
Barry, 1st Lt. E. F., Hdqrs. 6th Corps Area, 1819 West Pershing Road, Chicago, Ill.
Baxter, Maj. C. R., Executive Section, Office, Chief of Ordnance, Washington, D. C.
Becker, 1st Lt. W. E., Ammunition Division, Office, Chief of Ordnance, Washington, D. C.
Bellinger, 1st Lt. J. B., Recruiting and Publicity Bureau, Governors Island, N. Y.
Blackmore, Maj. P. G., Rock Island Arsenal, Rock Island, Ill.
Boatwright, Maj. W. P., Watertown Arsenal, Watertown, Mass.
Bodine, Maj. R. N., Fort Sam Houston, Texas.
Bomar, Capt. E. C., Ordnance School, Watertown Arsenal, Watertown, Mass.
Booth, Maj. L. D., Aberdeen Proving Ground, Md.
Booton, Maj. J. G., Harvard University, Cambridge, Mass.
Borden, Maj. W. A., Harvard University, Cambridge, Mass.
Bowlin, Capt. R. L., Hdqrs. 1st Corps Area, Army Base, Boston 9, Mass.
Breen, 1st Lt. J. J., Hdqrs. 6th Corps Area, 1819 West Pershing Road, Chicago, Ill.
Brett, Maj. M. L., San Francisco District Ordnance Office, 58 Sutter Street, San Francisco, Calif.
Bricker, Col. E. D., Watervliet Arsenal, Watervliet, N. Y.
Broberg, 1st Lt. W. S., Rock Island Arsenal, Rock Island, Ill.
Brooks, Maj. J. A., Jr., Military Personnel Section, Office, Chief of Ordnance, Washington, D. C.
Brown, Capt. J. E., Erie Ordnance Reserve Depot, Lacarne, Ohio.
Burgey, 1st Lt. S. S., Fort Bliss, Texas.
Burns, Maj. J. H., Army War College, Washington, D. C.
Buyers, Maj. A. S., Hdqrs. 5th Corps Area, Fort Hayes, Ohio.
Bricker, Capt. L. M., University of Michigan, Ann Arbor, Mich.
Cabell, Capt. D. C., Watertown Arsenal, Watertown, Mass.
Campbell, Capt. H. L., University of Cincinnati, Cincinnati, Ohio.
Campbell, Maj. L. H., Artillery Division, Office, Chief of Ordnance, Washington, D. C.
Capron, Maj. W. A., Aberdeen Proving Ground, Md.
Casad, Lt. Col. A. F., Raritan Arsenal, Metuchen, N. J.
Case, Maj. R. W., Hdqrs. 7th Corps Area, Omaha, Nebr.
Chase, Maj. E. H., Pig Point Ordnance Reserve Depot, Pig Point, Va.
Chavin, Capt. R. S., Frankford Arsenal, Philadelphia, Pa.
Christmas, Capt. J. K., Aberdeen Proving Ground, Md.
Churchill, Capt. H. W., Ordnance Specialists' School, Raritan Arsenal, Metuchen, N. J.
Clark, Maj. T. A., Field Service, Office, Chief of Ordnance, Washington, D. C.
Clark, Maj. W. L., Statistics and Industrial War Plans Section, Office, Chief of Ordnance, Washington, D. C.
Clay, Maj. W. L., Infantry and Aircraft Armament Division, Office, Chief of Ordnance, Washington, D. C.
Clement, Maj. J. K., Aberdeen Proving Ground, Md.
Coffey, Capt. J. W., U. S. Military Academy, West Point, N. Y.
Collins, Maj. E., San Antonio Arsenal, San Antonio, Texas.
Conrad, Capt. T. W., Watertown Arsenal, Watertown, Mass.
Coupland, 1st Lt. R. C., McCook Field, Dayton, Ohio.
Craig, Capt. D. W., Camp Lewis, Wash.
Crain, Maj. J. K., Picatinny Arsenal, Dover, N. J.
Crane, 1st Lt. R. Z., Philippine Ordnance Depot, Manila, P. I.
Crawford, Capt. J. S., Philippine Ordnance Depot, Manila, P. I.
Crim, Capt. L. P., Boston District Ordnance Office, 200 Devonshire Street, Boston, Mass.
Crump, Capt. I. A., Picatinny Arsenal, Dover, N. J.
Custis, 1st Lt. A. B., Frankford Arsenal, Philadelphia, Pa.
Daniels, Capt. R. W., Ordnance School, Watertown Arsenal, Watertown, Mass.
Darby, 1st Lt. M. E., Fort Eustis, Va.
Davis, Maj. H. C., Hdqrs. Organized Reserves, 333 Brix Building, Fresno, Calif.
Davis, 1st Lt. M. H., Edgewood Arsenal, Edgewood, Md.
Deitrick, 1st Lt. C. H., Charleston Ordnance Reserve Depot, Charleston, S. C.
D'Espinosa, 2nd Lt. W. J., Pig Point Ordnance Reserve Depot, Pig Point, Va.
Devenbeck, 2nd Lt. F. C., Aberdeen Proving Ground, Md.

Deylitz, 1st Lt. P. L., U. S. Military Academy, West Point, N. Y.
Dickson, Col. T. C., Watertown Arsenal, Watertown, Mass.
Dillon, Capt. Leo J., Ordnance School, Watertown Arsenal, Watertown, Mass.
Drewry, Capt. G. H., Infantry and Aircraft Armament Division, Office, Chief of Ordnance, Washington, D. C.
Eddy, 1st Lt. G. G., Hdqrs. 8th Corps Area, Fort Sam Houston, Texas.
Elliot, 1st Lt. A. D., Panama Ordnance Depot, Corozal, C. Z.
Elliott, Capt. S. H., Field Service, Office, Chief of Ordnance, Washington, D. C.
Ely, Capt. H. B., Frankford Arsenal, Philadelphia, Pa.
Englehart, Maj. F. A., Rock Island Arsenal, Rock Island Ill.
Erwin, 1st Lt. J. M., Artillery Division, Office, Chief of Ordnance, Washington, D. C.
Faymonville, Maj. P. R., New York District Ordnance Office, Room 810, 39 Whitehall Street, New York, N. Y.
Fidlar, Capt. J. B., Picatinny Arsenal, Dover, N. J.
Fletcher, 2nd Lt. L. S., Hawaiian Department, Fort Shafter, T. H.
Ford, Maj. A. W., Aberdeen Proving Ground, Md.
Ford, Capt. E. L., Ordnance School, Watertown Arsenal, Watertown, Mass.
Frank, Maj. S. H., Hdqrs. 2nd Corps Area, Governors Island, N. Y.
Freeman, 1st Lt. J. W., Camp Lewis, Wash.
Gatchell, Maj. O. J., Panama Ordnance Depot, Corozal, C. Z.
Gaugler, Maj. R. L., Hdqrs. Organized Reserves, Graham Building, 14th and E. Sts., Washington, D. C.
Gerber, Capt. T. C., Hdqrs. 5th Corps Area, Fort Hayes, Ohio.
Gerhardt, Capt. W. R., Ordnance School, Watertown Arsenal, Watertown, Mass.
Gibson, Capt. J. A. B., Fort Sam Houston, Texas.
Gilbert, Capt. F. I., Hdqrs. 1st Corps Area, Army Base, Boston 9, Mass.
Gillespie, Maj. A. G., Hdqrs. 6th Corps Area, Chicago, Ill
Gillespie, Maj. J. B., Militia Bureau, Washington, D. C.
Goebert, Capt. E. C., Rock Island Arsenal, Rock Island, Ill.
Gorton, Capt. W. T., Hawaiian Department, Schofield Barracks, T. H.
Graham, Maj. G. W., Ordnance Specialists' School, Raritan Arsenal, Metuchen, N. J.
Grubbs, Maj. D. C. T., Hdqrs. 7th Corps Area, Omaha, Neb.
Grum, 1st Lt. A. F., Hdqrs. 8th Corps Area, Fort Sam Houston, Texas.
Gruver, 2nd Lt. E. S., Ordnance School, Watertown Arsenal Watertown, Mass.
Guion, Capt. J. L., University of Chicago, Chicago, Ill.
Hall, Capt. D. C., Field Service, Office, Chief of Ordnance, Washington, D. C.
Haney, Capt. J. B., Raritan Arsenal, Metuchen, N. J.
Hannum, Maj. R. H., Army Industrial College, Washington, D. C.
Hamilton, Capt. W. C., Field Service, Office, Chief of Ordnance, Washington, D. C.
Hardigg, Maj. W. B., Picatinny Arsenal, Dover, N. J.
Hardy, Capt. R. E., Buffalo District Ordnance Office Watervliet Arsenal, Watervliet, N. Y.
Harmon, Maj. K. B., Rock Island Arsenal, Rock Island, Ill.
Harris, Maj. C. T., Jr., Executive Section, Office, Chief of Ordnance, Washington, D. C.
Harris, Capt. J. P., Picatinny Arsenal, Dover, N. J.
Harrison, 2nd Lt. E. H., Ordnance School, Watertown Arsenal, Watertown, Mass.
Hart, Capt. C. E., Aberdeen Proving Ground, Maryland.
Hartrick, Capt. G. R., Hawaiian Department, Schofield Barracks, T. H.
Hatcher, Capt. J. L., Technical Staff, Office, Chief of Ordnance, Washington, D. C.
Hatcher, Maj. J. S., Frankford Arsenal, Philadelphia, Pa.
Hauseman, 1st Lt. D. N., Ordnance School, Watertown Arsenal, Watertown, Mass.
Hayes, Maj. T. J., Hdqrs. 9th Corps Area, Presidio of San Francisco, Calif.
Heiss, 2nd Lt. G. K., Fort Bragg, N. C.
Hendry, 1st Lt. Earl, Ordnance School, Watertown Arsenal, Watertown, Mass.
Henry, Capt. W. J., Aberdeen Proving Ground, Md.
Hirsch, 1st Lt. G. W., Benicia Arsenal, Benicia, Calif.
Hof, Col. Samuel, Hdqrs. 2nd Corps Area, Governors Island, N. Y.
Hofstetter, Capt. C. F., Langley Field, Va.
Hogan, 2nd Lt. R. J., Ordnance School, Watertown Arsenal, Watertown, Mass.
Holman, 1st Lt. J. L., New York District Ordnance Office, 39 Whitehall St., New York, N. Y.
Holmes, Capt. J. G., Fort Monroe, Va.
Holmes, Capt. T. W., Springfield Armory, Springfield, Mass.
Horney, Col. O. C., Frankford Arsenal, Philadelphia, Pa.
Hubbell, Capt. R. L., Ordnance School, Watertown Arsenal, Watertown, Mass.
Huff, 1st Lt. S. P., Watertown Arsenal, Watertown, Mass.
Hughes, Maj. E. S., Command and General Staff School, Fort Leavenworth, Kans.
Huling, Capt. John, Ordnance Specialists' School, Raritan Arsenal, Metuchen, N. J.
Jenks, Lt. Col. G. F., Rock Island Arsenal, Rock Island, Ill.
Jervey, Capt. T. M., Aberdeen Proving Ground, Md.
Johnson, Maj. A. B., Hawaiian Department, Honolulu, T. H.
Joiner, Capt. W. H., Raritan Arsenal, Metuchen, N. J.
Jordan, Lt. Col. H. B., Command and General Staff School Fort Leavenworth, Kans.
Joyes, Brig. Gen. J. W., Chief of Field Service, Office, Chief of Ordnance, Washington, D. C.
Keck, Capt. C. H., Hdqrs. 2nd Corps Area, Governors Island, N. Y.
Kelly, Capt. D. C., Hdqrs. 4th Corps Area, Atlanta, Ga.
Kelly, Capt. P. K., Aberdeen Proving Ground, Md.
Kennedy, Capt. G. S., Aberdeen Proving Ground, Md.
Kiehl, Maj. P. J. R., Hdqrs. 8th Corps Area, Fort Sam Houston, Texas.
Kimble, Capt. S. R., Hdqrs. 7th Corps Area, Omaha, Neb.
King, Col. D. M., Rock Island Arsenal, Rock Island, Ill.
Kirk, Maj. James, Rock Island Arsenal, Rock Island, Ill.
Kresge, Capt. M. W., Ammunition Division, Office, Chief of Ordnance, Washington, D. C.
Krupp, Maj. Oscar, Watervliet Arsenal, Watervliet, N. Y.
Kutz, Maj. H. R., Hdqrs. 3rd Corps Area, New Standard Oil Building, Baltimore, Md.
Larned, Maj. W. E., Hdqrs. 1st Corps Area, Army Base, Boston 9, Mass.
Larr, 2nd Lt. David, Aberdeen Proving Ground, Md.
Lavin, Capt. G. S., Delaware Ordnance Reserve Depot, Pedricktown, N. J.
Lee, Maj. R. H., Hawaiian Department, Honolulu, T. H.
Leedy, 2nd Lt. Myron, Aberdeen Proving Ground, Md.
Lemon, Maj. G. F., Savanna Ordnance Reserve Depot, Savanna, Ill.
Leonard, 2nd Lt. L. C., Aberdeen Proving Ground, Md.
Lewis, Maj. B. O., Artillery Division, Office, Chief of Ordnance, Washington, D. C.
Long, Capt. J. A., Fort Eustis, Va.
Luke, Capt. I. A., Picatinny Arsenal, Dover, N. J.

Luse, Capt. A. H., Hdqrs. 3rd Corps Area, Standard Oil Building, Baltimore, Md.

Lynn, Capt. E. A., Charleston Ordnance Reserve Depot Charleston, S. C.

MacDonald, Maj. J. Q., Frankford Arsenal, Philadelphia, Pa.

MacGregor, Maj. S. H., Fort Benning, Ga.

MacMorland, Capt. E. E., Aberdeen Proving Ground, Md.

McFarland, Maj. Earl, U. S. Military Academy, West Point, N. Y.

McGehee, 2nd Lt. A. J., Aberdeen Proving Ground, Md.

McGregor, 1st Lt. D. G., Bridgeport District Ordnance Office, Springfield Armory, Springfield, Mass.

McInerney, 2nd Lt. J. E. B., Ordnance School, Watertown Arsenal, Watertown, Mass.

McIntyre, Capt. J. D., Springfield Armory, Springfield, Mass.

McMahon, Capt. F. A., Pittsburg District Ordnance Office, 1014 Diamond Bank Building, Pittsburg, Pa.

McPherson, 2nd Lt. W. L., Picatinny Arsenal, Dover, N. J.

Marsh, Maj. Raymond, Aberdeen Proving Ground, Md.

Mather, Maj. John, Army Industrial College, Washington, D. C.

Maxwell, Maj. R. L., Fort Bliss, Texas.

Melasky, Capt. H. M., Aberdeen Proving Ground, Md.

Meek, Capt. S. St. P., Frankford Arsenal, Philadelphia, Pa.

Melin, Capt. R. F., Philippine Ordnance Depot, Manila, P. I.

Menger, Capt. C. H., Birmingham District Ordnance Office, 938 Martin Building, Birmingham, Ala.

Merrill, Capt. Gyles, Benicia Arsenal, Benicia, Calif.

Mettler, Maj. C. G., American Embassy, London, England.

Meyns, 1st Lt. L. J., Military Personnel Section, Office, Chief of Ordnance, Washington, D. C.

Miles, Maj. F. H., Picatinny Arsenal, Dover, N. J.

Miller, Capt. Leland A., Caterpillar Tractor Co., San Leandro, Calif.

Minton, Capt. H. C., Watertown Arsenal, Watertown, Mass.

Minton, Capt. H. E., Hdqrs. 9th Corps Area, Presidio of San Francisco, Calif.

Mitchell, 1st Lt. Franklin, Watertown Arsenal, Watertown, Mass.

Moody, Maj. L. B., War Department, General Staff, Washington, D. C.

Morgan, 1st Lt. C. H., Army Industrial College, Washington, D. C.

Mortimer, Capt. R. P., Fort Sam Houston, Texas.

Munroe, Lt. Col. J. E., War Department, General Staff, Washington, D. C.

Murphy, Capt. E. A., San Antonio Arsenal, San Antonio, Texas.

Niblo, 1st Lt. Urban, Ordnance School, Watertown Arsenal, Watertown, Mass.

Nickerson, Maj. L. A., Ordnance School, Watertown Arsenal, Watertown, Mass.

Nisley, Capt. H. A., U. S. Military Academy, West Point, N. Y.

Nix, Maj. R. R., Office, Assistant Secretary of War, Washington, D. C.

Nixon, 1st Lt. T. H., Aberdeen Proving Ground, Md.

O'Hern, Col. E. P., Army War College, Washington, D. C.

O'Leary, 1st Lt. Clarence, Raritan Arsenal, Metuchen, N. J.

O'Leary, Maj. Herbert, Springfield Armory, Springfield, Mass.

Olmstead, Capt. B. R., Camp Meade, Md.

Orcutt, Capt. J. W., Erie Ordnance Reserve Depot, LaCarne, Ohio.

Osborn, Capt. N. W., Fort Benning, Ga.

O'Shaughnessy, Maj. P. J. (Ret.), Administration Division, Office, Chief of Ordnance, Washington, D. C.

Outland, Capt. G. W., Fort Sill, Okla.

Partridge, Maj. C. E., Benicia Arsenal, Benicia, Calif.

Peirce, 1st Lt. J. B., Ordnance Specialists' School, Raritan Arsenal, Metuchen, N. J.

Perrin, 1st Lt. A. C., Ordnance Specialists' School, Raritan Arsenal, Metuchen, N. J.

Pinger, Maj. R. W., University of California, Berkeley, Calif.

Presbrey, Maj. O. H., Panama Ordnance Depot, Corozal, C. Z.

Proctor, 1st Lt. J. W., Ordnance School, Watertown Arsenal, Watertown, Mass.

Quinton, Maj. A. B., Aberdeen Proving Ground, Md.

Ramsey, Maj. N. F., Command and General Staff School, Fort Leavenworth, Kans.

Randall, Capt. W. V., Aberdeen Proving Ground, Md.

Read, Lt. Col. J. H., Springfield Armory, Springfield, Mass.

Reed, Capt. C. S., Picatinny Arsenal, Dover, N. J.

Reed, 1st Lt. C. W., Camp Meade, Md.

Reed, 1st Lt. F. F., Watervliet Arsenal, Watervliet, N. Y.

Reedall, 1st Lt. H. M., Ordnance School, Watertown Arsenal, Watertown, Mass.

Regad, 2nd Lt. E. D., Delaware Ordnance Reserve Depot, Pedricktown, N. J.

Rehm, Capt. H. W., Fort Bragg, N. C.

Reimel, Capt. S. E., Camp Meade, Md.

Rice, Maj. H. L., Office, Assistant Secretary of War, Washington, D. C.

Richards, Maj. W. K., Hawaiian Ordnance Depot, Honolulu, T. H.

Richardson, Maj. C. T., Aberdeen Proving Ground, Md.

Rising, 1st Lt. H. R., Ordnance School, Watertown Arsenal, Watertown, Mass.

Ritchie, Capt. S. B., Watertown Arsenal, Watertown, Mass.

Roberts, Maj. C. M., St. Louis District Ordnance Office, Missouri State Life Insurance Building, St. Louis, Mo.

Rogers, Capt. J. A., Hdqrs. 5th Corps Area, Fort Hayes, Ohio.

Rogers, Capt. L. R., Frankford Arsenal, Philadelphia, Pa.

Root, Capt. J. A., Massachusetts Institute of Technology, Cambridge, Mass.

Rose, Maj. J. B., Technical Staff, Office, Chief of Ordnance, Washington, D. C.

Rothrock, 1st Lt. A. D., Frankford Arsenal, Philadelphia, Pa.

Rowland, 1st Lt. G. T., Rock Island Arsenal, Rock Island, Ill.

Ruggles, Brig. Gen. C. L'H., Chief of Manufacture, Office, Chief of Ordnance, Washington, D. C.

Rutherford, Maj. H. K., Office, Assistant Secretary of War, Washington, D. C.

Safford, Capt. H. F., Ammunition Division, Office, Chief of Ordnance, Washington, D. C.

Saunders, 1st Lt. O. A., Aberdeen Proving Ground, Md.

Sayler, Maj. H. B., Ordnance Specialists' School, Raritan Arsenal, Metuchen, N. J.

Schimelfenig, Maj. C. A., Office, Assistant Secretary of War, Washington, D. C.

Schull, Col. H. W., Springfield Armory, Springfield, Mass.

Sears, Maj. Robert, Field Service, Office, Chief of Ordnance, Washington, D. C.

Serrem, Capt. M. M., Watervliet Arsenal, Watervliet, N. Y.

Shaffer, Capt. F. C., Philadelphia District Ordnance Office, 1325 Widener Building, Philadelphia, Pa.

Shaler, 1st Lt. Harrison, Raritan Arsenal, Metuchen, N. J.

Sheridan, Maj. H. H. K., Hawaiian Department, Schofield Barracks, Honolulu, T. H.
Shinkle, Lt. Col. E. M., Hawaiian Department, Honoluiu, T. H.
Shurtleff, Maj. D. K., Statistics and War Plans Section, Office, Chief of Ordnance, Washington, D. C.
Simpson, Maj. B. W., Command and General Staff School, Fort Leavenworth, Kans.
Skinner, Capt. A. H., Georgia School of Technology, Atlanta, Ga.
Slattery, 1st Lt. J. W., Curtis Bay Ordnance Reserve Depot, South Baltimore, Md.
Slaughter, Capt. W. R., Aberdeen Proving Ground, Md.
Smith, 1st Lt. E. W., Ordnance Specialists' School, Raritan Arsenal, Metuchen, N. J.
Smith, Maj. T. J., Ammunition Division, Office, Chief of Ordnance, Washington, D. C.
Soderholm, Capt. W. H., Chicago District Ordnance Office, 600 West Jackson Blvd., Chicago, Ill.
Somers, Maj. R. H., Harvard University, Cambridge, Mass.
Spalding, Maj. S. P., Hdqrs. 9th Corps Area, Presidio of San Francisco, Calif.
Steese, Maj. C. M., Fort Sill, Okla.
Stewart, Lt. Col. G. H., Augusta Arsenal, Augusta, Ga.
Stokes, 1st Lt. J. H., Jr., Fort Benning, Ga.
Stribling, Capt. S. R., Kelly Field, Tex.
Strickland, Capt. N. H., Field Service, Office, Chief of Ordnance, Washington, D. C.
Stuart, Maj. A. J., Technical Staff, Office, Chief of Ordnance, Washington, D. C.
Studler, 1st Lt. R. R., Infantry and Aircraft Armament Division, Office, Chief of Ordnance, Washington, D. C.
Sucher, 1st Lt. J. G., Fort Bliss, Tex.
Taber, 1st Lt. T. R., Lehigh University, Bethlehem, Pa.
Taylor, 1st Lt. G. M., U. S. Military Academy, West Point, N. Y.
Taylor, Maj. Roger, Office, Assistant Secretary of War, Washington, D. C.
Thummel, Maj. C. B., Hdqrs. 7th Corps Area, Omaha, Nebr.
Townsend, Capt. S. A., Savanna Ordnance Reserve Depot, Savanna, Ill.
Traeger, Maj. C. H., Curtis Bay Ordnance Reserve Depot, South Baltimore, Md.
Trumbower, Capt. W. C., Miller Field, N. Y.
Tschappat, Col. W. H., Chief of Technical Staff, Office, Chief of Ordnance, Washington, D. C.
Underwood, Lt. Col. S. S., Hdqrs. 4th Corps Area, Atlanta, Ga.
Vander Hyden, Capt. W. F., Office, Assistant Secretary of War, Washington, D. C.
Van Gieson, 1st Lt. L. M., Ordnance Specialists' School, Raritan Arsenal, Metuchen, N. J.
Vincent, 1st Lt. T. K., Ordnance School, Watertown Arsenal, Watertown, Mass.
Wagner, Captain H. U., Army Industrial College, Washington, D. C.
Waldmann, Maj. C. A., Field Service, Office, Chief of Ordnance, Washington, D. C.
Walker, Maj. C. A., Manufacturing Service, Office, Chief of Ordnance, Washington, D. C.
Wall, Lt. Col. G. L., Philippine Ordnance Depot, Manila, P. I.
Walters, 1st Lt. J. W., Raritan Arsenal, Metuchen, N. J.
Warner, Capt. W. W., Augusta Arsenal, Augusta, Ga.
Wells, Capt. G. M., Aberdeen Proving Ground, Md.
Wentz, 1st Lt. R. R., Panama Ordnance Depot, Corozal, C. Z.
Wesson, Lt. Col. C. M., Aberdeen Proving Ground, Md.
Westervelt, Lt. Col. W. I., American Embassy, Paris, France.
Wheeler, Capt. J. A., Raritan Arsenal, Metuchen, N. J.
Whelen, Lt. Col. Townsend, Manufacturing Service, Office, Chief of Ordnance, Washington, D. C.
Whitney, 1st Lt. C. A., Cleveland District Ordnance Office, 2112 Keith Building, Cleveland, Ohio.
Wilhelm, Maj. G. P., Command and General Staff School, Fort Leavenworth, Kan.
Wilkins, Capt. H. S., Baltimore District Ordnance Office, 200 Scott Street, Baltimore, Md.
Williams, Maj. Gen. C. C., Chief of Ordnance, Washington, D. C.
Willink, 2nd Lt. Arthur, Ordnance School, Watertown Arsenal, Watertown, Mass.
Willis, 1st Lt. H. A., Hawaiian Department, Honolulu, T. H.
Wilson, Capt. Vennard, Statistics and Industrial War Plans Section, Office, Chief of Ordnance, Washington, D. C.
Wilson, Capt. W. I., U. S. Military Academy, West Point, N. Y.
Wilson, Maj. W. P., Frankford Arsenal, Philadelphia, Pa.
Winningstad, Capt. O. P., Army Industrial College, Washington, D. C.
Wipprecht, Capt. Read, Army Industrial College, Washington, D. C.
Woodberry, Maj. J. H., Field Service, Office, Chief of Ordnance, Washington, D. C.
Woodbury, 1st Lt. G. C., Cornell University, Ithaca, N. Y.
Woody, 1st Lt. G. A., Frankford Arsenal, Philadelphia, Pa.
Wotkyns, Capt. G. L., Springfield Armory, Springfield, Mass.
Young, Maj. C. G., Picatinny Arsenal, Dover, N. J.
Young, Maj. W. C., Fort Bragg, N. C.
Zeller, 2nd Lt. G. A., Ordnance School, Watertown Arsenal, Watertown, Mass.
Zornig, Maj. H. H., Ammunition Division, Office, Chief of Ordnance, Washington, D. C.

Maj. Gen. Charles P. Summerall Appointed Chief of Staff

THE Secretary of War announced recently the selection of Maj. Gen. Charles Pelot Summerall as the next Chief of staff, succeeding Maj. Gen. John L. Hines, effective early in next December.

General Summerall was born near Lake City, Florida, March 4, 1867. He attended the public schools and for three years was a student at the Porter Military Academy, Charleston, S. C. He then returned to Florida and taught school for two years. On June 16, 1888, he entered the U. S. Military Academy. During his four years as a cadet he was appointed Color Corporal, Senior First Sergeant, and First Captain. Upon graduation, June 12, 1892, he joined the First Infantry and was assigned to Benicia Barracks, California. In March, 1893, he transferred to the Fifth Artillery at the Presidio of San Francisco. His entire service from this date until he was made a general officer was with the Artillery. In 1896 General Summerall went with his battery to Fort Hamilton, N. Y., where he remained until 1898. In April, 1898, he was appointed aide-de-camp to Maj. Gen. William Montrose Graham and later to Brig. Gen. A. C. M. Pennington, who commanded the Department of the Gulf with headquarters at Atlanta, Ga. Upon the outbreak of the insurrection in the Philippines he joined the Fifth Artillery, sailed for Manila and took part in various expeditions against the insurgents the following year. He was recommended to

Congress for brevet by the War Department in 1902. He was promoted first lieutenant in 1900.

He took part in the Boxer Campaign with Reilly's battery in the assault of the Chinese positions at Peitsang and Yangtsun. During the assault and capture of the Imperial City and the Forbidden City, his guns accompanied the storming troops. He was recommended to be a brevet major by the Commanding General of the American Forces. In 1901 he returned to the United States and was stationed at Fort Walla Walla, Washington, where he was promoted captain. In 1902 he was ordered to Alaska, where he located and planned the construction of Fort William H. Seward. In August, 1903, he proceeded to Chickamauga Park, Ga., for duty. In September, 1905, he was ordered to duty at the U. S. Military Academy as Senior Instructor in Artillery Tactics. He remained at West Point until 1911, when he was promoted to major and assigned to command a battalion of the Third Field Artillery at San Antonio, Texas. In August, 1911, he was ordered to Fort Myer, Va., for station. While at Fort Myer he located and afterwards purchased for the Government the artillery range at Tobyhanna, Pa. From 1914 to 1917 he was on duty in the Militia Bureau of the War Department. He was promoted lieutenant-colonel in June, 1916, and colonel in April, 1917. In May, 1917, he proceeded to England and France, studying organization and training of the British and French armies.

In August, 1917, he was appointed brigadier general of the National Army and assigned to the command of the 67th Field Artillery Brigade of the 42nd Division. He sailed for France October 18th. On December 22, 1917, he took command of the First Artillery Brigade of the First Division and found the Division preparing to enter the line north of Toul. These were the first American troops to hold a sector. When the German drive began in March, 1918, the First Division proceeded to Picardy, where it took over the Cantigny Sector. In May, 1918, Cantigny was captured as a result of the first American offensive.

In June, 1918, General Summerall was appointed a major general and was assigned to the command of the First Division. He commanded this Division during the terrific fighting at Soissons where, after most heroic efforts, the Division took all of its objectives; and at the St. Mihiel where the Division was charged with connecting with the attack on the west of the salient. He again commanded in the first phase of the Meuse-Argonne.

On October 11, 1918, General Summerall was promoted to the command of the Fifth Army Corps which occupied the center of the American line. This corps was distinguished for its rapid and overwhelming advance in the assaults that occurred from then until the Armistice.

After the Armistice General Summerall commanded successively the Fifth Army Corps and the Ninth Army Corps in France, and the Fourth Army Corps in Germany. He was one of the American generals invited to be present at Versailles at the signing of the treaty of peace. In July, 1919, he was appointed a member of the Allied Mission of Generals at Fiume. He returned to the United States with General Pershing in September, 1919. General Summerall then commanded the First Division at Camp Zachary Taylor, Kentucky, and later at Camp Dix, N. J. In the meantime he had been appointed a brigadier general in the Regular Army, January, 1919, and a major general in the Regular Army in May, 1920. On August 5, 1921, he assumed command of the Hawaiian Department where he remained until August 12, 1924. Following his foreign service tour in Hawaii he assumed command of the Eighth Corps Area with headquarters at San Antonio, Texas, in October, 1924, remaining there three months. On January 16, 1925, he succeeded Major General Robert L. Bullard in command of the Second Corps Area with headquarters at Governor's Island, N. Y. He has remained at this post to date.

General Summerall was awarded the Distinguished Service Cross with the accompanying citation:

"Major General Charles P. Summerall, then Major General, First Division and Fifth Army Corps, United States Army, for extraordinary heroism in action on July 19, 1918, before Berzy-le-Sec, near Soissons, during the Aisne-Marne offensive. General Summerall, commanding the First Division, with great gallantry and with utter disregard for his own safety, visited the extreme front lines of his division and personally made a reconnaissance of the position in the face of heavy hostile machine gun and artillery fire, exhorting his men to renew the attack on Berzy-le-Sec, promising them powerful artillery support, and so encouraged them by his presence and example that they declared their readiness to take the town for him. Due to his great courage and utter disregard for his own safety, the men of his division were inspired to enormous and heroic efforts, capturing Berzy-le-Sec the next morning under terrific enemy fire, and later in the day the division reached all of its objectives."

While in France he was awarded the Distinguished Service Medal with citation as follows:

"For exceptionally meritorious and distinguished services. He commanded in turn a brigade of the First Division in the operations near Montdidier, the First Division during the Soissons and St. Mihiel offensives and in the early battles of the Argonne-Meuse advance, and the Fifth Army Corps in the latter battles of this advance. In all these important battles his calm courage, his clear judgment and his soldierly character had a marked influence in the attainment of the successes of his commands."

General Summerall was awarded the Croix de Guerre with palm for an Army citation which reads:

"General Summerall has developed the technical knowledge and the valor of his Brigade to a degree which makes this organization able to perform all the missions that could be incumbent upon it. By his energy, his courage and his indefatigable activity, he has shown himself to be a leader of the first order."

He was decorated as Commander of the Legion of Honor by France, and Grand Officer of the Crown by Belgium, as Commander of the Order of the Crown by Italy, with the Order of Prince Danilo I by Mentenegro, and with the Military Medal by Panama.

General Summerall also wears the Spanish-American War Bage, the Philippine Campaign Badge with two silver stars representing citations for gallantry in action, the China Campaign Badge with two silver citation stars, and the World War Campaign Badge with five palms for major operations.

In 1901 he married Miss Laura Mordecai, daughter of the late Brig. Gen. Alfred Mordecai, Ordnance Department, U. S. A. General Summerall holds the degree of LL. D. which was conferred on him by Hobart College.

California Post, Army Ordnance Association, Elects Officers

THE California Post, Army Ordnance Association, held its third annual election of officers on October 6, 1626, by letter ballot as provided by its constitution. The following officers were elected:

President: P. E. Holt, 1520 North Eldorado Street, Stockton, Cal., Caterpillar Tractor Co.;

Vice-President: C. N. Black, 58 Sutter Street, San Francisco, Cal., formerly Colonel, Ordnance Department, 1917-1918;

Directors (term expiring November 30, 1928):

W. E. Creed, 245 Market Street, San Francisco, Cal., President, Columbia Steel Corporation, President, Pacific Gas and Electric Co.;

D. C. Jackling, Hobart Building, San Francisco, Cal. (on duty in charge of Government powder plants by special appointment of the President during the War);

W. H. Oliver, Fourth and Madison Streets, Oakland, Cal., Vice-President and General Manager, Oliver Continuous Filter Co., Oakland, California;

Reese Llewellyn, of the Llewellyn Iron Works, 1200 North Main Street, Los Angeles, Cal.

The Post now has 88 members of whom 12 are junior members, an increase of 16 in the past year.

Philadelphia Post, A. O. A., Being Organized

ON September 21, 1926, there was held in the rooms of the Army and Navy Club, Philadelphia, a meeting of members of the Army Ordnance Association and Ordnance Reserve Officers residing in and around Philadelphia. The purpose of the meeting was two-fold: to organize a local Post of the Army Ordnance Association, and to discuss the war game with the personnel of the Philadelphia District Ordnance Office organization.

Mr. John C. Jones, Chief of the Philadelphia Ordnance District, presided and delivered the address of the evening. His talk covered the activities of the Philadelphia district in the procurement of munitions during the World War, and outlined its procurement problem in a future emergency. Col. Odus C. Horney, Commanding Officer, Frankford Arsenal, also spoke. He stressed the importance of perpetuating the knowledge gained during the World War regarding manufacture of munitions and the desirability of disseminating Ordnance knowledge during peace time to provide a trained Ordnance cadre for the future. Lieut. Col. Archibald Hubard, Ordnance Reserve, addressed the meeting on the three months School of the Line course given at Fort Leavenworth for reserve officers. His description of the course was filled with a lot of good humor and was very instructive. Capt. L. A. Codd, Assistant Secretary of the Army Ordnance Association, spoke on the necessity for civilian cooperation with the Ordnance Department in peace time, and outlined the aims and purposes of the Army Ordnance Association.

About forty Army Ordnance Association members and reserve officers were present. Petitions for formation of a local post were circulated.

The discussion of the war game with the district personnel ended with an expression on the part of each member present of a desire to actively cooperate.

The members of the Army Ordnance Association in Philadelphia and vicinity have been circularized for the purpose of securing petitions for formation of a local Ordnance Post. Ninety petitions have been forwarded to the National Headquarters in Washington and the date of December 9th has been set for the first formal meeting, at which the charter will be presented. It is expected that members of the Philadelphia Ordnance District Advisory Board will be in attendance at this meeting.

Recently Commissioned Ordnance Reserve Officers

THE following have accepted reserve commissions since the publication of the July-August issue of ARMY ORDNANCE:

Lieut. Col. Louden A. Harriman, Ord. Res., 206 South Main St., Princeton, Ind.

Lieut. Col. Hubert G. Stanton, Ord. Res., Cornwall-on-Hudson, N. Y.

Lieut. Col. Paul Weeks, Ord. Res., 5718 Russell St., Detroit, Mich.

Lieut. Col. Earl W. Whitney, Ord. Res., Box 147, Wewoka, Okla.

Maj. Edward B. Danenhower, Ord. Res., Pittsburgh Athletic Association, Pittsburgh, Pa.

Maj. William P. Dodge, Ord. Res., 2 Elm St., Westerly, R. I.

Maj. George F. Fleming, Ord. Res., 1904 Riverside Drive, Trenton, N. J.

Maj. William T. Hensley, Ord. Res., R. R. "M," Box 308, Indianapolis, Ind.

Maj. Chester L. Jones, Ord. Res., care U. S. Embassy, 5 Rue de Chaillot, Paris, France.

Maj. Irven W. Kenney, Ord. Res., R. R. 1, Box 143, South Tacoma, Wash.

Maj. Spencer G. Kuhn, Ord. Res., 1031 Avondale Ave., Cincinnati, Ohio.

Maj. Louis B. Myers, Ord. Res., 67 Conduit St., Annapolis, Md.

Maj. Russell S. Penniman, Jr., Ord. Res., P. O. Box 34, West Berkeley, Calif.

Maj. James W. Spradling, Ord. Res., 404 Austin St., Sparta, Wis.

Maj. William H. Weingar, Ord. Res., 88 Maplewood Ave., W. Hartford, Conn.

Maj. John T. Wurster, Ord. Res., 2015 B Ave., Cedar Rapids, Iowa.

Capt. Wayne M. Blair, Ord. Res., 720 Ash St., Ottawa, Kans.

Capt. John A. Colborn, Ord. Res., 737 Quebec St., N. W., Washington, D. C.

Capt. Roy Collier, Ord. Res., Hotel Aragon, Atlanta, Ga.

Capt. Raymond W. Combs, Ord. Res., 1036 Grant St., Boulder, Colo.

Capt. Howard L. Fairlamb, Ord. Res., Box 143, Port Deposit, Md.

Capt. Richard J. Forsyth, Ord. Res., 117 Riddell St., Greenfield, Mass.

Capt. Clarence E. Gage, Ord. Res., 501 Dreier Blvd., Evansville, Ind.

Capt. Earle Gatchell, Ord. Res., 326 E. 51st St., New York, N. Y.

Capt. William B. Hampton, Ord. Res., 515 Glenn Ave. Ellwood City, Pa.

Capt. Just C. Jensen, Ord. Res., 2805 Myrtle Ave., N. E., Washington, D. C.
Capt. John O. Keller, Ord. Res., 163 Park Ave., State College, Pa.
Capt. Carl D. McCready, Ord. Res., 211 South Main St., Du Bois, Pa.
Capt. Walter B. Mehl, Ord. Res., 547 East 1st Ave., Roselle, N. Y.
Capt. Harry M. Mitchell, Ord. Res., 1028 Langdon St., Alton, Ill.
Capt. Frank M. Oensel, Ord. Res., Hq. 4th Corps Area, Atlanta, Ga.
Capt. Karl L. Pohlman, Ord. Res., 1264 Cleveland Heights Blvd., Cleveland, Ohio.
Capt. Raymond B. Silverman, Ord. Res., 861 9th St., Douglas, Ariz.
Capt. Frederick G. Tickell, Ord. Res., 652 Forest Ave., Palo Alto, Calif.
Capt. Edward G. Topie, Ord. Res., 1005 Broad St., Newcastle, Ind.
Capt. George A. Yates, Ord. Res., 2738 Utah St., St Louis, Mo.
1st Lieut. Walter K. Bailey, Ord. Res., 1840 Windermere St., East Cleveland, O.
1st Lieut. Cyril E. Baston, Ord. Res., 101 Biddle St., Wilkinsburg, Pa.
1st Lieut. Joseph F. Carroll, Ord. Res., Hotel Taft, New Haven, Conn.
1st Lieut. Waldo L. Emerson, Ord. Res., 896 Paxton Road, Cleveland, Ohio.
1st Lieut. Alfred G. Glode, Ord. Res., 73 Silver St., Springfield, Mass.
1st Lieut. Douglas F. Linsley, Ord. Res., 15 Maple St., Stratford, Conn.
1st Lieut. Monro MacCloskey, Ord. Res., 30 N. Michigan Ave., Chicago, Ill.
1st Lieut. John H. F. Madgett, Ord. Res., 1144 Parkwood Blvd., Schenectady, N. Y.
1st Lieut. Richard F. Mann, Ord. Res., 1525 Winton Ave., Lakewood, Ohio.
1st Lieut. Albert E. Nollett, Ord. Res., Box 197, St. Paul Park, Minn.
1st Lieut. James N. Pearre, Ord. Res., Hqrs. 4th Corps Area, Atlanta, Ga.
1st Lieut. John H. Pleasants, Ord. Res., 1700 South Noland St., Independence, Mo.
1st Lieut. Ernest F. Schaefer, Ord. Res., 520 Storer Ave., Akron, Ohio.
1st Lieut. Karl C. Schoepfle, Ord. Res., 3333 Dellwood Road, Cleveland Heights, Ohio.
1st Lieut. Harry H. Schultz, Ord. Res., 921 South 40th St., Louisville, Ky.
1st Lieut. Horace E. Stout, Ord. Res., 2525 Park Ave., Indianapolis, Ind.
1st Lieut. Beverley St. G. Tucker, Ord. Res., 203 St. Claire Ave., N. E., Cleveland, Ohio.
1st Lieut. Morris K. Voedisch, Ord. Res., Burd High Compression Ring Co., Rockford, Ill.
1st Lieut. George C. Willson, Ord. Res., 16 West Van Ness Ave., Rutherford, N. J.
1st Lieut. Walter T. Wilson, Ord. Res., Cornwall-on-Hudson, N. Y.
2nd Lieut. Edwin A. Adey, Jr., Ord. Res., Dongan Hills, S. I., N. Y.
2nd Lieut. Frank O. Agel, Ord. Res., 32 Goshen St., Paterson, N. J.
2nd Lieut. Charles L. Ager, Jr., Ord. Res., 129 N. Indiana Ave., Watertown, N. Y.
2nd Lieut. Dixon R. Allen, Ord. Res., Box 472, Van Buren, Ark.
2nd Lieut. Charles J. Anderson, Ord. Res., 1007 N. Main St., Jamestown, N. Y.
2nd Lieut. Gordon O. Andrews, Ord. Res., 183 Crowley Ave., Buffalo, N. Y.
2nd Lieut. Ernest D. Arwood, Ord. Res., P. O. Box 42, Fort Mills, S. C.
2nd Lieut. Richard W. Avery, Ord. Res., 172 Franklin St., Arlington, Mass.
2nd Lieut. Ernest A. Bamman, Ord. Res., 46 Park Place, Princeton, N. J.
2nd Lieut. Charles H. Beardsley, Ord. Res., 814 Center St., Wilkinsburg, Pa.
2nd Lieut. DeLamar T. Bell, Ord. Res., Sandersville, Ga.
2nd Lieut. Earl W. Bemis, Ord. Res., 821 West 28th St., Erie, Pa.
2nd Lieut. Arthur E. Benson, Ord. Res., Y. M. C. A., 654 Bergen Ave., Jersey City, N. J.
2nd Lieut. Raymond T. Bete, Ord. Res., 419 Washington St., Stoughton, Mass.
2nd Lieut. Arthur C. Bivins, Jr., Ord. Res., 91st St., Miami, Fla.
2nd Lieut. John W. Blemker, Ord. Res., 3148 Albion Rd., Shaker Heights, Cleveland, Ohio.
2nd Lieut. Franklin C. Blocksom, Ord. Res., 2535 Hillegass Ave., Berkeley, Cal.
2nd Lieut. William F. Bramstedt, Ord. Res., 2184 Green St., San Francisco, Cal.
2nd Lieut. Harry T. Broadbent, Ord. Res., 113 Sterling Ave., Providence, R. I.
2nd Lieut. Edward H. Brown, Ord. Res., Martin, Ga.
2nd Lieut. Lionel J. Brunton, Ord. Res., 2105 Walnut St., Boulder, Colo.
2nd Lieut. Herbert M. Brusman, Ord. Res., 126 Richmond Ave., Dayton, Ohio.
2nd Lieut. Duncan F. Buchanan, Ord. Res., 2500 College Ave., Berkeley, Cal.
2nd Lieut. Michael J. Caragher, Ord. Res., Fort Douglas, Utah.
2nd Lieut. Donald C. Chase, Ord. Res., 39 Lincoln St., Stoneham, Mass.
2nd Lieut. George D. Clucas, Ord. Res., 192 Highgate Ave., Buffalo, N. Y.
2nd Lieut. Lawrence R. Cole, Ord. Res., 203 17th St., Wilmette, Ill.
2nd Lieut. John H. Collins, Jr., Ord. Res., 217 East Gordon St., Savannah, Ga.
2nd Lieut. William H. Collison, Ord. Res., R. F. D. 1, St. Francisville, Ill.
2nd Lieut. Bemsley W. Conn, Ord. Res., 667 W. Philadelphia Ave., Detroit, Mich.
2nd Lieut. Richard E. Connet, Ord. Res., Box 153, Fairfield, Conn.
2nd Lieut. Francis E. Cook, Ord. Res., 1435 South 18th St., Birmingham, Ala.

2nd Lieut. Charles S. Cooley, Ord. Res., 3258 Montana Ave., Cincinnati, Ohio.
2nd Lieut. Luther W. Copeland, Ord. Res., care T. B. Westmoreland, Fort Smith, Ark.
2nd Lieut. Richard L. Cory, Ord. Res., Oceanside, Cal.
2nd Lieut. Gerald A. Cowan, Ord. Res., 1579 Baymiller St., Cincinnati, Ohio.
2nd Lieut. Clifford F. Criley, Ord. Res., 3631 Askew, Kansas City, Mo.
2nd Lieut. Bartel J. Di Santo, Ord. Res., 1 Main St., Matawan, N. J.
2nd Lieut. Harry W. Dodd, Ord. Res., Russelville, Ark.
2nd Lieut. Collis E. Durden, Ord. Res., Stillmore, Ga.
2nd Lieut. Alvan P. Eddy, Ord. Res., 462 North 3rd Ave., Saginaw, Mich.
2nd Lieut. Edwin C. Eddy, Ord. Res., 423 E. Kearsley St., Flint, Mich.
2nd Lieut. Emerson W. Eddy, Ord. Res., 5531 Pulaski Ave., Germantown, Pa.
2nd Lieut. John J. Egan, Ord. Res., 112 Grant Ave., Brooklyn, N. Y.
2nd Lieut. Jack H. Faulkner, Ord. Res., 3508 Admiral Way, Seattle, Wash.
2nd Lieut. Morgan W. Felt, Ord. Res., 38 Watching Ave., Upper Montclair, N. J.
2nd Lieut. Lester E. Francis, Ord. Res., 3711 Columbia Ave., Cincinnati, Ohio.
2nd Lieut. Afton L. Fraser, Ord. Res., 2609 Rathbone Road, Lincoln, Nebr.
2nd Lieut. Herman C. Fromuth, Jr., Ord. Res., 5745 N. Marshall St., Philadelphia, Pa.
2nd Lieut. Alfred S. Gardiner, Ord. Res., Box 17, Macon, Ga.
2nd Lieut. Leland H. Gardiner, Ord. Res., 1423 Hyde Park Blvd., Chicago, Ill.
2nd Lieut. Luis Gibson, Ord. Res., 70 Oakwood Ave., Upper Montclair, N. J.
2nd Lieut. Lyle E. Glenn, Ord. Res., Stockbridge, Mich.
2nd Lieut. Harold P. Goller, Ord. Res., 31 No. 6th St., Reading, Pa.
2nd Lieut. Frederick L. Green, Ord. Res., 423 W. St. Joseph St., Lansing, Mich.
2nd Lieut. Ben M. Gregory, Ord. Res., 600 Turner Ave., Grand Rapids, Mich.
2nd Lieut. Philip E. Gruber, Ord. Res., 797 Ave C, Bayonne, N. J.
2nd Lieut. Charles E. Gus, Ord. Res., 917 83rd St., Brooklyn, N. Y.
2nd Lieut. George W. Hamblet, Jr., Ord. Res., 2093 Adelbert Road, Cleveland, Ohio.
2nd Lieut. Clarence W. Hamilton, Ord. Res., Georgia Ry. & Power Co., Atlanta, Ga.
2nd Lieut. William F. Hamilton, Ord. Res., 741 West 2nd Ave., Corsicana, Tex.
2nd Lieut. Decatur D. Hankins, Jr., Ord. Res., 319 E. 47th St., Savannah, Ga.
2nd Lieut. Edwin L. Harder, Ord. Res., 190 Auburn Ave., Buffalo, N. Y.
2nd Lieut. Edward J. Hardin, Ord. Res., care Henry James, Abilene, Tex.
2nd Lieut. Howard L. Harrington, Ord. Res., 1148 Garrett Ave., Niagara Falls, Niagara, N. Y.
2nd Lieut. Hugh C. Harris, Ord. Res., 1537 Herschell St., Jacksonville, Fla.
2nd Lieut. Glen D. Harsh, Ord. Res., 48 Hemphill Ave., Atlanta, Ga.
2nd Lieut. John J. Hart, Ord. Res., 239 East 53rd St., New York, N. Y.
2nd Lieut. Howard E. Hennig, Ord. Res., 2535 37th St., N. W., Washington, D. C.
2nd Lieut. Guido R. Henry, Ord. Res., 1234 S. 51st St., Philadelphia, Pa.
2nd Lieut. Delos E. Hibner, Jr., Ord. Res., 525 Liberty Blvd., DuBois, Pa.
2nd Lieut. Baylor O. Hickman, Ord. Res., 231 West Main St., Louisville, Ky.
2nd Lieut. Wallace W. Hoge, Ord. Res., 2449 Overlook Road, Cleveland, Ohio.
2nd Lieut. Edward J. Holahan, Ord. Res., Noroton Heights, Conn.
2nd Lieut. Donald A. Holm, Ord. Res., 1704 Geddes Ave., Ann Arbor, Mich.
2nd Lieut. James C. Holmes, Ord. Res., Woodbury, Ga.
2nd Lieut. Carlos H. Horne, Ord. Res., 129 Briarcliff Road, Atlanta, Ga.
2nd Lieut. Joseph Y. Houghton, Ord. Res., 7 Longfellow Road, Wellesley Hills, Mass.
2nd Lieut. Clement O. Johnson, Ord. Res., 205 West 38th St., Savannah, Ga.
2nd Lieut. Marion T. Johnson, Ord. Res., 2006 Whitaker St., Savannah, Ga.
2nd Lieut. Henry W. Jones, Ord. Res., Bethayres, Pa.
2nd Lieut. William F. Jones, Ord. Res., Buckley, Wash.
2nd Lieut. Carter M. Judah, Ord. Res., 146 21st Ave., San Francisco, Cal.
2nd Lieut. Wesley M. Kaylor, Ord. Res., Box 271, Ft. Gaines, Ga.
2nd Lieut. James A. Keene, Jr., Ord. Res., 400 Temple St., New Haven, Conn.
2nd Lieut. Henry F. King, Ord. Res., 77 Bigelow St., Brighton, Mass.
2nd Lieut. Ralph L. Kirby, Ord. Res., 1718 W. Grand Ave., Detroit, Mich.
2nd Lieut. Paul K. Klaesius, Ord. Res., 309 Birchwood Ave., Hamilton, Baltimore, Md.
2nd Lieut. Claude W. Kniffin, Ord. Res., Lew Beach, Sullivan Co., N. Y.
2nd Lieut. John A. Laughlin, Ord. Res., 1017 East Lake Drive, Decatur, Ga.
2nd Lieut. John E. Lawlor, Ord. Res., care Adj. General's Office, Camp Lewis, Wash.
2nd Lieut. Reuel D. Layman, Ord. Res., Berrien Center, Mich.
2nd Lieut. Abram Leffler, Ord. Res., 3201 Guilford Ave., Baltimore, Md.
2nd Lieut. Henry W. Ligon, Ord. Res., 3909 Spruce St., Philadelphia, Pa.
2nd Lieut. Franklyn C. Lindley, Ord. Res., 102 Spadina Parkway, Pittsfield, Mass.
2nd Lieut. Reuben Lisson, Ord. Res., 237 West 109th St., New York, N. Y.
2nd Lieut. Howard A. Light, Ord. Res., 67 Spencer St., Winsted, Conn.
2nd Lieut. William S. Loeb, Ord. Res., Bent and Accomac Roads, Wyncote, Pa.
2nd Lieut. Guy B. Lynes, Ord. Res., 318 Electric & Gas Bldg., Atlanta, Ga.

2nd Lieut. Louis Lyon, Jr., Ord. Res., 115 Church St., Sumter, S. C.
2nd Lieut. Donnell D. MacCarthy, Ord. Res., 404 Oak Ave., Ithaca, N. Y.
2nd Lieut. John R. MacDonell, Ord. Res., City Y. M. C. A., Atlanta, Ga.
2nd Lieut. Harold E. MacKeen, Ord. Res., 261 Ridgefield St., Hartford, Conn.
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2nd Lieut. John W. McCaffrey, Ord. Res., 7623 Bennett Ave., Chicago, Ill.
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2nd Lieut. Harry G. Miner, Old. Res., 3610 W. Broadway, Louisville, Ky.
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Patents

Brief Descriptions of Inventions of Interest to Ordnance Engineers

Compiled by W. N. Roach, Chief, Patent Section, Office of the Chief of Ordnance

Ammunition

A FEW patents relating to ammunition have recently been issued, the most interesting of which are as follows:

Albert E. Henderson has been granted patent No. 1,596,180 pertaining to ordnance projectiles. The invention covered by this patent is a special point or nose for projectiles so constructed as to minimize air pressure, this object being attained by vanes or ribs on the nose inclined to the axis of the shell and preferably convex on the side in the direction of rotation of the shell and concave on the opposite side.

Samuel Wiley, of Picatinny Aresnal, has received patent No. 1,596,224, for a fuze. The fuze covered by this patent is intended more especially for use with bombs. The object of the invention is to provide a fuze having an air propeller unscrewed spindle carrying a spring-actuated firing pin with an improved form of locking means and release therefor.

Valentine Schlafer, assignor to Rheinische Metallwaaren Und Machinenfabrik, has been granted patent No. 1,596,378, for a fuze for projectiles. The fuze covered by this patent is intended, primarily, for use in antiaircraft projectiles and provides a longitudinal passage through which air is supplied to the time train ring to insure proper burning thereof.

Patent No. 1,600,303, for a combination fuze, has been granted to Maj. J. K. Crain, Ord. Dept., U. S. A., Commanding Officer, Picatinny Arsenal, together with Messers. Arthur Adelman, Fred Hawkes, and H. G. Towner of the Office of the Chief of Ordnance. This is a combination fuze in which the mechanism for securing varying actions is positioned axially of the fuze when set for functioning.

Fred Olsen, of the Technical Division, Picatinny Arsenal, has been granted patent No. 1,593,135 for a high explosive. The high explosive mixture covered by this patent consists broadly of a nitro-aromatic compound and an absorbent material.

Artillery

THE following patents relating to artillery have been recently granted by the Patent Office:

Thomas A. Conlon, of the Artillery Division, Office of the Chief of Ordnance, has been granted patent No. 1,594,455, for a traversing mechanism. This invention provides a traversing mechanism in which, during traverse, clearance is maintained between the top and bottom carriage while, upon firing the gun, the load is transmitted to the bottom carriage.

Letters Patent No. 1,596,568, for a compensating sight for aerial gunnery, has been issued to A. H. Woodward, assignor to International Register Co. The invention covered by this patent aims to provide an adjustable front sight.

Herman Schuler, assignor to Rheinische Metallwaaren Und Maschinenfabrik, has been granted patent No. 1,596,629, for a gun for high and low angle firing. The device covered by this patent consists of a gun carriage having forward and rear portions and an intermediate carriage connecting said portions and pivotally connected to the rear portion and provided with means for trunnioning a gun and its cradle on said carriage. The construction permits the gun and cradle to be locked to the intermediate carriage and elevated by swinging about the pivotal connection of the intermediate carriage with the rear portion of the main carriage, or the intermediate carriage to be locked in any adjusted position about its pivotal connection with the rear portion of the main carriage and gun and cradle swung upon its trunnions.

Hannibal C. Ford, assignor to Ford Instrument Company, Inc., has been granted patent No. 1,597,031, for a fire control instrument. The main object of the structure covered by this patent is to provide means to prevent the unrestrained swinging of the control gyroscope and its connected parts when the gyroscope it not acting as a control element.

Harry C. Zimmerman, of the Artillery Division, Office of the Chief of Ordnance, has been granted patent No. 1,600,302, for a trail lock. The invention covered by this patent provides a lock especially adapted to trails of the split trail type, which is easily operated to lock the trails to or unlock them from the limber and which will not permit a trail to jar loose when traveling over rough ground.

Small Arms

THE following are some recent patents relating to small arms:

Hans Schmeisser has been granted patent No. 1,586,048, for a firing mechanism for machine pistols. The invention covered by this patent aims to provide a firing mechanism which will automatically fire a number of shots or a single shot, as desired, with readily operable means for changing from setting for firing a number of shots automatically to the setting for firing a single shot.

Patent No. 1,586,413, has been granted to J. J. Doornbos, for a gun sight. This invention aims to provide a front and rear sight, both of which are substantially rotatable disks, the front sight provided with a number of projections or beads of varying sizes any one of which may

be brought into position by rotation of the disk and the rear sight provided with varying forms of apertures or peeps, any one of which may be brought into position when desired by rotation of the disk.

Edward S. R. Adams, assignor of one-half to E. J. W. Slade, has been granted patent No. 1,586,434, for small arm and machine gun. This patent covers a gun of the gas-operated type in which the piston actuated by the discharged gases acts directly upon the feeding and ejecting mechanism without the intervention of any intermediate delay mechanism.

Patent No. 1,586,810, has been granted to Isaack N. Johansson, for a firearm. This patent covers a revolver in which the trigger has a sliding or rectilinear movement instead of a pivotal movement and in which a mechanism is provided whereby the revolver may be used as a self-cocking one or may be changed to a manually cocked one.

John T. Kewish has been granted patent No. 1,587,003 for an automatic firearm. This patent covers a number of details of construction in a rifle designed for either single shot or automatic action.

Werner C. L. Haubroe has been granted patent No. 1,588,887 for a machine gun with an exchangeable barrel. The main object of the invention covered by this patent is to provide a bolt for holding the trigger plate and butt end in normal position of such character that same may be operated to permit the exchange of the barrel without complete removal of the bolt thereby avoiding liability of losing the bolt.

Mr. Haubroe, has also been granted patent No. 1,588,888, for a drum-shaped cartridge magazine for machine guns or the like. The main object of this invention appears to be the provision of means for feeding cartridges uniformly into the gun at all elevations.

The same inventor has also been granted patent No. 1,594,365, for a tripod for machine guns. The tripod is provided with a frame for receiving the gun having upwardly open bearings for the trunnions on the gun and a spring latch at its rearward end adapted to engage the gun to hold the same in place, the object of the structure being to permit the gun to be readily secured in place on the tripod or removed therefrom.

Mr. Haubroe has also been granted patent No. 1,596,177, for a trigger mechanism for automatic small firearms. The trigger mechanism is designed to provide a number of safety features, the object of which is to assure a firearm in which premature firing is not likely to take place.

Louis Hendler, of Frankford Arsenal, assignor to the Secretary of War in trust for the Government of the United States, has been granted patent No. 1,593,721, for a tracer mixture. The mixture covered by this patent consists broadly of an alkali earth metal, a carbonate of the same metal, a fuel and a binder.

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Books

The Origin of the Next War. By John Bakeless. New York: The Viking Press. 1926. $2.50.

THIS book is best summarized by its own sub-title, "A Study in the Tensions of the Modern World." It is a true study in the scientific manner with all the facts on both sides of the question presented in a logical way and terminating in a most conservative conclusion. As one reads through the book it is pleasant to note that the author has "no axe to grind" and no panacea to offer but is merely presenting materials with which the reader's mind may work in forming an intelligent opinion as to the future of international relations. Paraphrased, the book concludes that it is possible to prevent war but not probable that it can be done for many centuries to come. The author has been an associate editor of "The Living Age."

The book opens with a discussion of the wars, minor and major, which have taken place since "the war to end war" which ended in 1918, from which it passes to a keen analysis of the fundamental causes of modern war. These Bakeless broadly groups under the general term economic causes. Chapters are devoted to each of the main subdivisions which are over-population and over-production, both shown to be the offspring of modern industrialism (or civilization, if one is optimistic). In keeping with the clear structure of this work the general discussion of these themes leads into a dissertation on the nations chiefly affected by them. This in the case of over-population touches mainly Italy, Japan and Germany while with reference to over-production and the consequent struggle for markets there is added to the above list England and the United States. While the above causes are considered the basic ones, the author holds out but little hope that anything can be done even to check the working out of these almost natural laws for many centuries to come. Coping intelligently with such sinister forces which have their roots in the centuries old self-interest of the common man is hardly to be thought of while the citizenry of the leading nations takes its greatest pleasures in its own mounting population and export curves.

Among the lesser causes of modern war the two chiefly mentioned are irridentism and a desire for access to the sea. The term irridentism is derived from Italia Irridenta (Webster spells it Italia Irredenta), or unredeemed Italy of the latter nineteenth century, and is applied to the general condition of large populations of one nationality subject to a foreign government. This condition which is always a fruitful source of trouble the author considers can be remedied by drastic political surgery such as Greece and Turkey, as well as Germany and Poland, have recently done by the wholesale transfer of populations rather than by transfers of land, which usually take place only as a result of war. Concerning the universal desire of nations to have access to the sea across their own territory the author is not so sanguine, but at least some such cases have been remedied which is more than can be said for the evils of industrialism discussed above.

If any criticism can be leveled at this excellent work it is, in the opinion of the reviewer, that comparatively little stress is laid on the struggles which the future holds for the United States in securing markets for its ever increasing exportable surplus of manufactured articles and in obtaining raw materials. It may be that this matter has been discussed fully in the author's previous work, "The Economic Causes of Modern War" (1921).

A valuable feature of the book is that the text is liberally supplied with references, making it possible for the interested reader to pursue this engaging subject further as no doubt many will. The style is pleasant and free; it is particularly enjoyable reading because it is singularly free from the cant and dogma usually associated with studies of this type. The discussion of weapons of the future, particularly tanks, is of special interest to officers of the Ordnance Department. This study is sincerely recommended to all American officers who are interested in the broader aspects of their profession as well as to all intelligent Americans who take an interest in international affairs. It is probably too much to hope that this exceptionally able work will reach some of those who need it most, viz.: the peace-at-any-price-pacifists, the "parlor reds" and the great body of well-meaning but uninformed seekers after a better world, whatever their "ism".

JOHN K. CHRISTMAS.

A History of Firearms. By Major H. B. C. Pollard. London: Geoffrey Bles. 1926.

A VERY comprehensive treatise on the history and development of hand arms for student and collector, including many plates of the finest examples of the gunmaker's art in all its stages. Should a gun enthusiast un-

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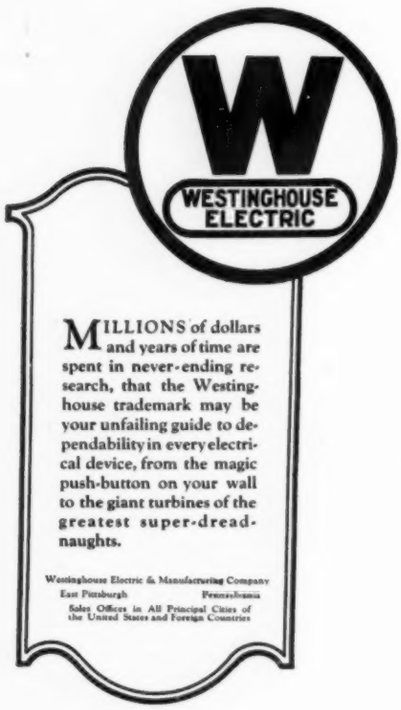
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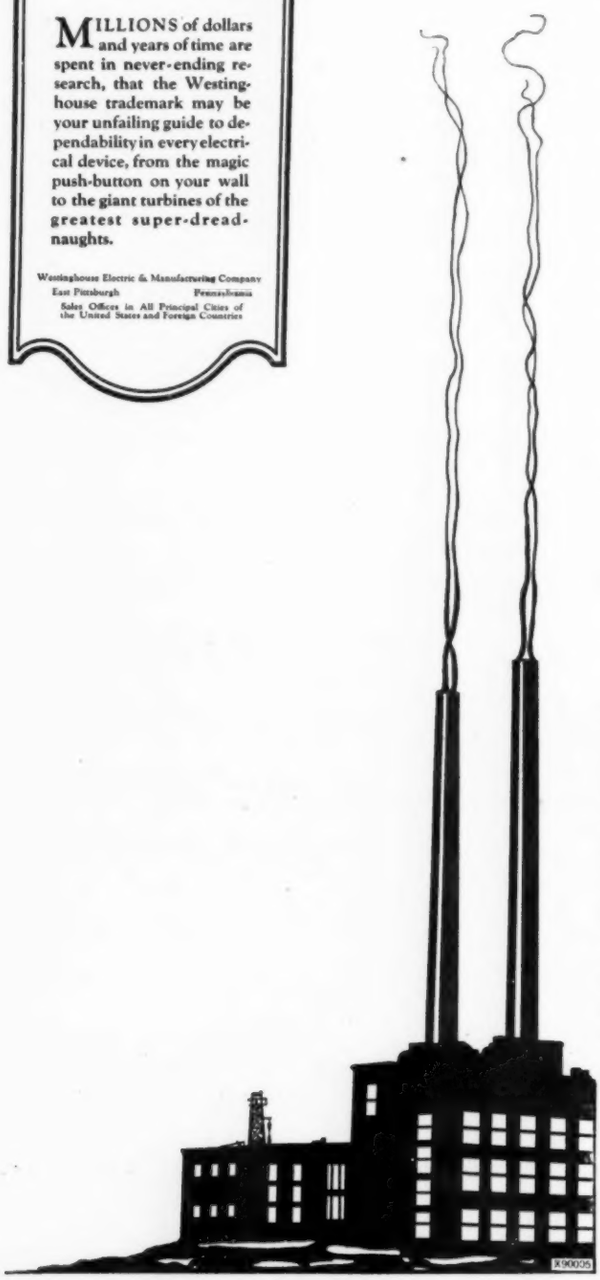

earth a strange looking weapon, he should be able to place it in its type and era by reference to this book. It is not intended to be a text for the ordnance engineer interested in the mechanical principles of locks, actions, and trigger mechanisms. It does however carry the reader entertainingly through the many stages of improvement from the old cumbersome, uncertain matchlock to the latest rapid-fire high-powered rifle and automatic pistol. A good reason, an underlying cause, usually existed for each step of advancement.

Interesting sidelights are given on the individuals who have been preëminent in firearms progress. The success of the Colt weapons is laid primarily to the energy, salesmanship, and capacity of Colonel Colt himself. It is true the first Colt weapons were not entirely successful but it is believed a statement by the author concerning the Colt automatic pistol used in the last war does not represent the general opinion on the matter in this country.

"The Colt proved as good as any other automatic pistol in service, but was generally deemed far inferior in reliability to the revolver."

In another instance, the Springfield rifle does not appear in a favorable light as the result of a rather surprising misstatement in view of the popularity of the weapon.

"In addition to the standard short Lee-Enfield of 1904, which is still the official rifle of the British services, there is a model known as the 1914 pattern Enfield .303, which was largely manufactured, but never used in war. This was a new rifle, since adopted as a Springfield model by the U. S."

The rifle referred to is probably that known as the U. S. Rifle Model of 1917, the Lee-Enfield manufactured for Great Britain by private concerns in this country in 1917 and modified to use Cal. .30 ammunition. These rifles are now in storage and were never preferred by U. S. troops to the Springfield.

A review of this book could not afford to overlook one passage in which the author expresses himself with great frankness on the relationship of the British Army authorities and the British National Rifle Association.

"It is pretty clear that this bred universal public civilian interest in the shortcomings of the Army rifle. Public pressure rather than any military zeal on the part of the professional soldier brought about rearmament with the breech loader. The soldiers, then as ever, hated anything new, and so long as the existing arm was pretty to drill with they loathed the idea of any change. The same principal operates today, and the Army may be depended on to the last musketry sergeant to oppose the introduction of any new rifle. Not because the new model will be an improvement (and they will doubt that!), but because it means a new drill and instructors will have to learn new rigmaroles. The instructors will be ably supported by regular officers of equal intelligence.

* * * * * * *

"We find this note of the battle between progressive brains and the Army, or as the army prefers to call it, 'the authorities,' as a recurring note in the history of small arms. It is the civilian who has always seen to it that our arms were not more than a decade behind those of rival and potentially hostile powers. The record of the National Rifle Association is not merely long lists of Bisley pot hunters. It is something far more valuable.

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Here in America we hardly believe that our National Rifle Association has quite as hostile an attitude toward our 'Army authorities' and hope never to give them cause. The Ordnance Department recognizes the great value of the N. R. A. and endeavors to help that organization in its efforts.

J. W. Coffey.

Aerostatics. By Prof. Edward P. Warner. New York: The Ronald Press Company. 1926. $3.25.

PROFESSOR Edward P. Warner's treatment of the subject of aerostatics should accomplish much toward the advancement of the study of the atmosphere from an aeronautical point of view. His discussion of the variables affecting the atmospheric density at different altitudes and his methods of determining the altitude of a given barometric pressure or density from known surface conditions are very interesting and instructive.

Much can be gained by those interested in the theory of ballooning by making a careful study of the statics of the full and flabby balloon and the dynamics of the spherical balloon.

This book should prove valuable to schools and colleges and those desiring a highly technical and theoretical discussion of the subject of aerostatics or the conditions affecting the equilibrium of bodies freely suspended in the atmosphere. It is one of the first books published in this country on aerostatics as applied to balloons and airships. The treatment of the subject is worthy of the author and an accomplishment of which he can be justly proud.

It is to be regretted that the space, limited to a single volume, and the great scope of the practical application of aerostatics to the theory of airship flights, necessarily limited Professor Warner to fundamental principles.

Harvey H. Holland.

The Slave Trade, Slavery and Color. By Thedore D. Jervey. Columbia, S. C.: The State Company.

MR. JERVEY'S book is truly "Light on a dark subject." It is popularly supposed that when a southerner speaks of the Negro it is only to damn him. Yet here is a book written by a southerner which is extremely fair and free from offense to the most sensitive gentlemen of color.

The history of the Negro race in America is covered in detail from colonial times and under British laws down to the latest race riots. In fact the author covers it almost too well as his wealth of statistics border on tediousness. The reader is willing to overlook this however because of the sincerity of the author and his familiarity with his subject.

The author clearly sets forth these facts: (1) White contact has undoubtedly improved the Negro; (2) The Whites of the South have benefited by the abolition of slavery; (3) Too large a proportion of Negro population retards the South; and (4) Diffusion by emigration is the solution of the Negro question.

The author believes that such great Southerners as Calhoun would have been still greater if their views on slavery had been broader, that the Civil War would not have taken place and that the South would today be much farther advanced. Mr. Jervey, as do most Southerners, considers that the reconstruction period was a national disgrace regardless of the necessity for the war and emancipation.

"The Slave Trade" has to be read to be appreciated, as it abounds in interesting facts and unknown bits of history. The author's style at times is a little confusing but it is all the more delightful for all that and one can not lay down his book without a better and a fuller knowledge of the "white man's burden." The book need not be read from a sense of duty or merely from a desire for knowledge as it is interesting enough to anyone of Southern sympathies without additional incentives.

G. P. Wilhelm.

Pyroxylin Enamels and Lacquers, Their Raw Materials, Manufacture and Application. By Samuel P. Wilson. New York: D. Van Nostrand Company. 1926. $3.00.

THIS book appears at an opportune time when the use nitrocellulose for pyroxylin enamels and lacquers for the finishing of automotive bodies is so rapidly increasing, and when rapid drying pyroxylin enamels which the amateur can apply with a brush, are being widely advertised. Nitrocellulose has become a factor of the greatest importance in the paint and varnish industry during recent years, and its use has brought about the introduction of new solvents, plasticisers, etc., which were formerly mere laboratory curiosities but are now produced in bulk at low cost. The dearth of up-to-date information on these subjects has been a handicap to both manufacturers and chemists interested.

Part I of the book is devoted to a discussion of the properties and methods of production of the many and diversified materials which may be used as components of lacquers, enamels, and similar finishes. These materials include pyroxylin, solvents such as alcohols, esters and ketones, non-solvents, plasticisers, gums, resins, pigments, and dyes. A number of the newer solvents and plasticisers which have recently assumed considerable importance are unfortunately given rather brief mention. Pigments and dyes are especially well discussed.

Part II treats of practical formulas, apparatus, and methods of manufacture of bronzing liquids, leather dopes, metal and wood lacquers, and lacquer enamels. The final chapters are devoted to methods of applying these finishes and to miscellaneous analytical methods. In general the subject is discussed in a clear and entertaining manner which holds the interest of the reader.

Users and manufacturers of pyroxylin products will undoubtedly find the book well worth the price. It is significant that, although it first appeared late in 1925, the book has already had its second printing.

C. G. Storm.

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